World Cancer Research Fund

American Institute for Cancer Research

CUP Continuous Update Project

Analysing research on cancer prevention and survival

Recommendations
and public health and policy implications

2018

World Cancer Research Fund International

World Cancer Research Fund UK

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Contents

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WORLD CANCER RESEARCH FUND NETWORK

Our Vision

We want to live in a world where no one develops a preventable cancer.

Our Mission

We champion the latest and most authoritative scientific research from around the world on cancer prevention and survival through diet, weight and physical activity, so that we can help people make informed choices to reduce their cancer risk.

As a network, we influence policy at the highest level and are trusted advisors to governments and to other official bodies from around the world.

Our Network

World Cancer Research Fund International is a not-for-profit organisation that leads and unifies a network of cancer charities with a global reach, dedicated to the prevention of cancer through diet, weight and physical activity.

The World Cancer Research Fund network of charities is based in Europe, the Americas and Asia, giving us a global voice to inform people about cancer prevention.

CUP Continuous Update Project

Analysing research on cancer prevention and survival

THIRD EXPERT REPORT

Our Continuous Update Project (CUP)

The Continuous Update Project (CUP) is World Cancer Research Fund Network's ongoing programme to analyse cancer prevention and survival research related to diet, nutrition and physical activity from all over the world. Among experts worldwide it is a trusted, authoritative scientific resource which informs current guidelines and policy on cancer prevention and survival.

Scientific research from around the world is continually added to the CUP's unique database, which is held and systematically reviewed by a team at Imperial College London. An independent panel of experts carries out ongoing evaluations of this evidence, and their findings form the basis of the WCRF Network's Cancer Prevention Recommendations (see inside back cover).

Through this process, the CUP ensures that everyone, including policymakers, health professionals and members of the public, has access to the most up-to-date information on how to reduce the risk of developing cancer.

The launch of World Cancer Research Fund Network's Third Expert Report, *Diet, Nutrition, Physical Activity and Cancer: a Global Perspective*, in 2018 brings together the very latest research from the CUP's review of the accumulated evidence on cancer prevention and survival related to diet, nutrition and physical activity. Recommendations and public health and policy implications is one of many parts that make up the CUP Third Expert Report: for a full list of contents see dietandcancerreport.org

The CUP is led and managed by World Cancer Research Fund International in partnership with the American Institute for Cancer Research, on behalf of World Cancer Research Fund UK, Wereld Kanker Onderzoek Fonds and World Cancer Research Fund HK.

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Key

References to other parts of the Third Expert Report are highlighted in purple.

Introduction

World Cancer Research Fund (WCRF) and American Institute for Cancer Research (AICR) champions the latest and most authoritative scientific research from around the world on cancer prevention and survival through diet, nutrition and physical activity to help people make informed lifestyle choices to reduce their cancer risk.

The cornerstone of WCRF/AICR's research is the Continuous Update Project. It is the world's largest source of scientific research on cancer prevention and survival through diet, nutrition and physical activity. A Panel of world-renowned independent experts in a variety of disciplines from across the globe reviews the findings of the CUP and uses their conclusions to develop the best cancer prevention advice and make Cancer Prevention Recommendations.

This part of the 2018 Third Expert Report presents the Panel's latest advice and Recommendations:

- **Section 1** explains why it is so important to prevent cancer and touches upon how to ensure efforts to do so are successful.
- **Section 2** summarises the latest findings of the CUP and presents the Panel's 10 global Cancer Prevention Recommendations. It also explains the context in which to view the Recommendations and the principles that underpin them.
- **Section 3** highlights strong evidence on risk factors for cancer that is not suitable for inclusion in the global Recommendations (for example, because the findings are relevant in specific areas of the world only) but is nevertheless important, with recommended actions where appropriate.
- **Section 4** describes the importance of policy action in influencing the broader 'upstream' determinants of cancer that are beyond people's personal control.
- **Section 5** draws conclusions.
- **Appendix 1** summarises related advice from other reports on preventing other non-communicable diseases (NCDs).
- **Appendix 2** outlines example policy options across an adapted framework that support cancer prevention.

This part of the Third Expert Report aims to help anyone who is keen to know how to prevent cancer. It may be particularly useful to:

- researchers, scientists, and medical and health professionals
- policymakers
- civil society organisations
- the media
- people looking to reduce their risk of cancer

1. Preventing and surviving cancer

Prioritising prevention

The case for prioritising the prevention of cancer is strong: cancer can take a heavy personal toll on those affected, and the global burden of cancer is high and rising, yet many cases of cancer are preventable. What is more, preventing cancer has additional benefits both for other common NCDs and for the planet.

Prevention of cancer and other NCDs remains important after a diagnosis, hence the Panel's Recommendation for cancer survivors (people who have been diagnosed with cancer, including those who have recovered from the disease).

The rising burden of cancer – a global issue

Cancer causes one in eight deaths worldwide [1] and has overtaken cardiovascular disease (CVD) as the leading cause of death in many parts of the world [2,3]. According to the International Agency for Research on Cancer (IARC), there were 14.1 million new cases of

cancer and 8.2 million deaths from cancer in 2012 [1]. This global cancer burden is expected to increase to 21.7 million cases and 13 million deaths by 2030, mainly owing to demographic change [1].

Yet, more people are living with and surviving cancer than ever before, at least in part because of earlier detection and the increasing success rates of treatment for several cancers [4]. For example, in the United Kingdom in 2010, an estimated 2 million people were living with cancer; this number is projected to increase to 4 million in 2030 [5]. This trend is shared by many countries around the world [4]. Globally, in 2012, an estimated 32.6 million people were living with cancer, 17 million in developed regions and 15.6 million in less developed regions (as measured by the Human Development Index) [6]. The number of cancer survivors is probably an underestimate, as data on cancer survival are not available in many parts of the world.

Treating cancer is expensive and is not always successful, and many treatment options are unavailable in less developed regions. Indeed, the overall economic cost of cancer is astonishing [**Box 1**].

Many cases of cancer can be prevented

Cancer can affect anyone, but some people are at a higher risk than others. Although some contributory causes of cancer, such as inherited factors, are fixed, a range of modifiable lifestyle and environmental factors also affect the risk of cancer [7–9]. These factors can have a strong influence on cancer risk, which is why many cases of cancer are preventable. Between 30 and 50 per cent of all cancer cases are estimated to be preventable [10].

Not smoking or using any form of tobacco, and avoiding other exposure to tobacco smoke, are the most important means of reducing cancer risk.

The next most important means of reducing risk, and the most important for people who do not smoke, is to maintain a healthy weight throughout life by consuming a healthy diet and being physically active [10]. Other risk factors include, but are not limited to, long-term infections, radiation, sun and tanning, and industrial chemicals [11]. Minimising exposure to these risk factors is another means of reducing cancer risk.

Box 1: Economic burden of cancer and other NCDs

The economic costs associated with the rising burden of cancer and NCDs are astonishing.

Globally, the total cost of cancer in 2030, including direct medical costs, non-medical costs and income losses, is projected to be US$458 billion. Between 2010 and 2030, the total lost economic output (that is, depletion of labour force) from cancer, CVD, diabetes, chronic respiratory disease and mental health conditions combined is projected to be US$46.7 trillion. This loss is equivalent to 75 per cent of global gross domestic product (GDP) in 2010 (US$63 trillion) [22].

The economic costs of cancer, as well as the financial burden of treating other NCDs, pose a significant challenge to patients, families, communities and governments around the world, especially in low- and middle-income countries facing multiple burdens of disease [23].

Box 2: Trends in NCDs over time and place

Trends in NCDs have varied over time and geographically.

Incidence rates of CVD have decreased dramatically in high-income countries, because of more effective treatment of risk factors and legal and regulatory policy interventions that have resulted in decreased rates of smoking. Associated mortality rates have decreased even further as a result of improvements in medical management [24, 25].

Incidence rates of cancer vary widely by country, with all-sites cancer rates highest in high-income countries [26]. Mortality rates for colorectal, breast and prostate cancers are decreasing in many high-income countries, because of screening, early detection and improved treatment, and at least in part because of decreases in known risk factors [26]. Mortality rates for lung cancer are falling due to reduced rates of smoking, driven mostly by men in high-income countries smoking less.

At the same time, incidence rates of CVD and cancer have increased dramatically in low- and middle-income countries as countries have adopted more 'Western lifestyles' [27].

The number of people with diabetes almost quadrupled between 1980 and 2014 (108 million to 402 million), with rates increasing faster in low- and middle-income countries than in high-income countries [28]. In addition, the burden of infection-related cancers is disproportionately high in low- and middle-income countries [28].

The Panel judges that avoidance of tobacco in any form, together with appropriate diet and nutrition, physical activity, and maintaining a healthy weight, have the potential over time to reduce much of the global burden of cancer. However, with current trends towards decreased physical activity [12] and increased body fatness [13], the global burden of cancer can be expected to continue to rise until these issues are addressed, especially with projections of an ageing global population [14].

Wider benefits of cancer prevention: non-communicable diseases and the planet

Trends in cancer rates are part of a broader global phenomenon of increases in NCDs that include cancer, diabetes and chronic respiratory disease, and at least in low- and middle-income countries, CVD [15] [**Box 2**].

Different NCDs share common underlying risk factors including diet, overweight and obesity, physical inactivity, alcohol consumption, tobacco use and certain long-term infections (e.g. *Helicobacter pylori*) [16, 17]. Therefore, approaches to preventing cancer can provide benefits across a range of NCDs.

The World Health Organization's Global Action Plan for the Prevention and Control of Non-Communicable Diseases 2013–2020 and the United Nations 2030 Agenda for Sustainable Development include global targets of reducing premature deaths from NCDs, including cancer, by 25 per cent by 2025 and by one-third by 2030 [18, 19].

Moreover, it is increasingly recognised that policy actions conducive to health are consonant with those needed to create a sustainable ecological environment [20, 21]. A coordinated policy approach therefore has benefits across several domains.

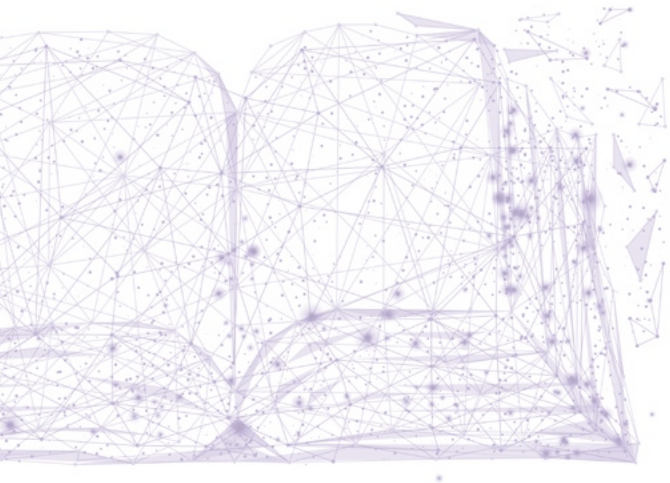
The CUP and the Cancer Prevention Recommendations

The Recommendations featured in this report are based on the findings of the CUP – a rigorous systematic review of the evidence relating diet, physical activity and body weight to the incidence of cancer, as well as an expert review of biological pathways (mechanisms) that could plausibly explain a causal link between the exposure and the risk of cancer. Recommendations are made only when the CUP Panel judges the evidence to be sufficiently strong (see Judging the evidence).

The Recommendations take the form of a series of general statements to be used by individuals, families, health professionals, communities and policymakers, as well as the media.

The goal of these Recommendations is to help people make healthy choices in their daily lives to reduce the risk of cancer and other diet-related NCDs.

Studies evaluating adherence to the Cancer Prevention Recommendations from the last Expert Report, published in 2007, have shown that the more people adhere to them, the greater the reductions in the risk of specific cancers, of cancer as a whole and of death from any cause [29–31]. The updated Recommendations in this report build on the 2007 Recommendations and are based on the best available scientific evidence globally.



The 'causes of the causes' of cancer

Knowledge of the causes of cancer, through the biological basis of the links between diet, nutrition, physical activity and cancer incidence, is critical to understanding how to prevent it.

However, simply informing people of lifestyle factors that cause, or protect against, cancer, and making recommendations about healthy behaviours are by themselves insufficient to bring about substantial, sustained changes in behaviour [32].

The Panel recognises that the causes of cancer that it has identified and which are the targets of the Cancer Prevention Recommendations are themselves determined by other factors that are outside the direct remit of the Panel. These broader determinants of health (the 'causes of the causes') are discussed in **Section 4**, the development of which was undertaken with a subgroup of members of World Cancer Research Fund International's Policy Advisory Group (PAG) who have expertise in this area.

A systematic review conducted for WCRF/AICR of the determinants of behaviour and effective interventions for changing behaviour [32] described major constraints on behaviour change that arise from broader factors outside most people's personal control. These 'upstream' factors may be social or economic, or relate to the physical or other environment, and may operate at local, national or global levels. These factors determine a 'choice architecture' that is a more important determinant of prevailing patterns of behaviour (including diet and activity) than the purposeful choices people make.

Although people's choices are influenced by their knowledge, attitudes and beliefs, these are poor predictors of behaviour. Much behaviour is not the result of active choice but is instead a passive reflection of social norms (determined by the wider upstream factors).

Therefore the effectiveness of efforts to change diet and activity depends substantially on policies that influence the upstream factors and the social norms that are the main determinants of people's behaviour. WCRF International's 2009 Policy Report systematically reviewed the evidence for the effectiveness of policies and made recommendations based on that review [32].

The importance of public health policy

While individuals may or may not choose healthy patterns of behaviour, governments have a prime responsibility, in protecting the health of their citizens, to create environments that are conducive to health. Public health policy, in the form of laws, regulations and guidelines, is therefore a critical determinant of population health.

In the past the major threats to people's health from the environment were noxious agents such as adulterated food and drink and air pollution. Although these have not disappeared, a major threat to health is now the poor-quality diet and low levels of activity typical of modern society [33].

Modern globalised food systems have reduced food insecurity to an extent and in more affluent societies have been important in reducing child mortality and extending life expectancy. But the quality of diet and levels of activity typical of affluent societies are not conducive to healthy ageing, so ill health and disability are common features of increasing age. Cancer is typically a feature of older age, and its prevention depends on creating an environment that encourages lifelong healthy eating and a physically active lifestyle.

A multisectoral approach

It is crucial that governments prioritise prevention to address the rising burden of cancer. Prevention must be a cornerstone of any cancer control plan and should encompass a multisectoral approach beyond health (including transport and infrastructure, environment, trade and investment, education, finance and agriculture) to address the broader determinants of cancer (the social and economic conditions that result in individual and group differences in cancer prevalence) and the inequalities in cancer control that they lead to.

Monitoring and registries

Monitoring of health and its determinants, and of disease, is a vital component of public policy, and contributes to its evaluation. Such monitoring depends on accurate data collection.

Data collected on cancer incidence and mortality in cancer registries is important for governments developing nationally appropriate policies to prevent and control cancer. Many parts of the world now have cancer registries that methodically collect information on the occurrence of cancer and related aspects [1]. However, many countries, especially low- and middle-income countries, lack population-based cancer registries, and those that do exist do not usually record relevant nutritional factors [34].

2. Recommendations for Cancer Prevention

Context

The Recommendations presented in this Report are designed to be used as the basis for action by people and to inform policy action to reduce the incidence of cancer in general.

Together, the individual Recommendations represent an integrated pattern of behaviours relating to diet and physical activity, and other factors that can be considered as a single overarching 'package'. Taken together, the Recommendations direct people towards healthy patterns of diet and physical activity, as well as other healthy ways of life.

An overall lifestyle

People do not eat foods in isolation but in combination, forming an overall diet or eating pattern. Different components of the diet (foods, drinks, nutrients) interact with one another, so that the impact of one factor may be influenced by the presence or absence of another. This emphasises the need to approach the Recommendations as a package, but it also adds complexity when interpreting observational evidence, because it makes it harder to identify singular effects attributable to individual dietary or other factors.

Although the Panel makes every effort to make individual Recommendations only when the evidence is strong enough, general clustering of health-related behaviours means that conclusions drawn from largely observational evidence must always have an element of doubt as to where true causality lies.

That said, the greater the degree of adherence to the Recommendations, the more likely it is that people will achieve the expected protection against cancer and other NCDs, and this relationship is supported by a growing body of research [29–31]. Therefore, the Panel's confidence in the protective effect from following all the Recommendations is even greater than that for any individual Recommendation.

The Recommendations in this Report are intended to help people adopt healthy patterns of eating and physical activity across the life course. Following them is likely to promote healthy body composition and nutritional adequacy. Moreover, a diet based on these Recommendations is likely to be 'nutrient dense' – containing foods and beverages with a relatively high concentration of vitamins and minerals, and other dietary constituents such as dietary fibre, thereby promoting good nutritional health, without excessive fats, added sugars or refined starches.

Realistic and achievable

The Recommendations have been designed to be culturally relevant throughout the world. They emphasise aspects of diet and nutrition, physical activity and body fatness that protect against cancer and can be achieved across different cultures. The Recommendations are quantified wherever possible; see **Box 3**.

The Panel has chosen to make quantified Recommendations that in its judgement would result in a real health gain and are achievable.

Even without fully achieving a stated Goal (the specific quantified advice for how to meet the Recommendation), a change toward the Goal is worthwhile – any change is likely to provide at least some benefit. A change in being physically active from 30 to 60 minutes a week, or a reduction in body fatness marked by a change in body mass index from 29 to 27 kg/m^2, while not meeting the Goals, would nevertheless be valuable for reducing cancer risk.

Regional issues and special circumstances

The 10 Recommendations and the associated Goals are generally relevant worldwide.

Some evidence is strong enough to support recommendations but not suitable for inclusion in a set of global recommendations for a variety of reasons. For example, the evidence may relate to foods or drinks that are relevant only in discrete geographical locations or to a public health issue that most people cannot influence themselves. In addition, sometimes a food or nutrient may affect the risk of different diseases in opposite directions, or information on dose may be inadequate, meaning it is not appropriate to make a recommendation.

These issues are covered in **Section 3**.

Prevention of other diseases

The risk of diseases other than cancer is also modified by diet, nutrition and physical activity.

The Cancer Prevention Recommendations take into account the prevention of other diseases. Authoritative recommendations from around the world on diet, nutrition and physical activity for the prevention of diet-related deficiency diseases and diet-related NCDs other than cancer were systematically reviewed for the 2007 Second Expert Report. For this Report, the Panel has methodically explored any substantive changes that might change those authoritative recommendations (see **Appendix 1**).

Box 3: Quantification of the Recommendations

Health professionals who advise on preventing cancer, people interested in reducing their risk of cancer and people involved in the development of public health policy need specific, relevant advice that they can act on. People need to know how much of what foods and drinks, what levels of body fatness and how much physical activity are most likely to protect against cancer. For these reasons, the Goals for each Recommendation are quantified whenever possible.

Translating an overall body of evidence into quantified recommendations is a challenge for all expert panels and cannot be an 'exact science'. Within any population, people differ from one another, and there are differences between populations as well. A single, numerical recommendation is not able to encompass completely these differing needs and so necessarily is imprecise.

Furthermore, the evidence rarely shows a clear point above or below which risk changes suddenly. Rather, there is usually a continuous relationship between an exposure, be it body fatness, physical activity, or level of consumption of a food or drink, and cancer risk. The shape of this 'dose response' may vary – sometimes it is a straight line, or it may be curved, for instance J-shaped or U-shaped.

All of these factors need to be taken into account when quantifying recommendations, which therefore involves judgement, even though the Cancer Prevention Recommendations are based on the best available evidence.

The Panel also used this approach when considering a lower end of the range for healthy body mass index (BMI), which does not derive from the evidence on cancer.

When quantifying the Recommendations and when considering the evidence from studies on cancer, the Panel also took into account ranges of intake of food and drink, and ranges of advisable body fatness and physical activity recommended in other reports on, for instance, other NCDs. Other panels have taken the same approach. In order to minimise confusion, the Panel has sometimes selected existing quantified guidance if it is consistent with the evidence on cancer prevention.

An important example is alcohol and coronary heart disease (CHD). In the past, it was thought that moderate consumption of alcoholic drinks reduced the risk of CHD and all-cause mortality compared with not drinking alcohol. However, it is not possible to be confident that the effect seen is truly attributable to alcohol and there is no justification for recommending drinking alcohol to protect against non-cancer health outcomes.

Diet, nutrition, physical activity and cancer – an overview of the Panel's judgements

The matrix presented here summarises all the strong evidence judgements of the Panel that are the basis of the 10 Cancer Prevention Recommendations.

The rows correspond to the cancer types (with cancer as the outcome) and to energy balance and body fatness (with weight gain, overweight and obesity as the outcome). The columns correspond to the exposures. Colours show the strength of the evidence (whether 'convincing', 'probable' or 'substantial effect on risk unlikely') and the direction of the effect (whether there is an increase, a decrease or no effect on the risk of cancer), as explained in the key.

Judgements of 'convincing' and 'probable' are normally strong enough to support a Recommendation, while judgements of 'limited – suggestive' generally are not. Each conclusion on the likely causal relationship between an exposure and outcome forms a part of the overall body of evidence that is considered during the process of making Cancer Prevention Recommendations. Any single conclusion does not represent a Recommendation in its own right. The 2018 Cancer Prevention Recommendations are based on a synthesis of all these separate conclusions, as well as other relevant evidence.

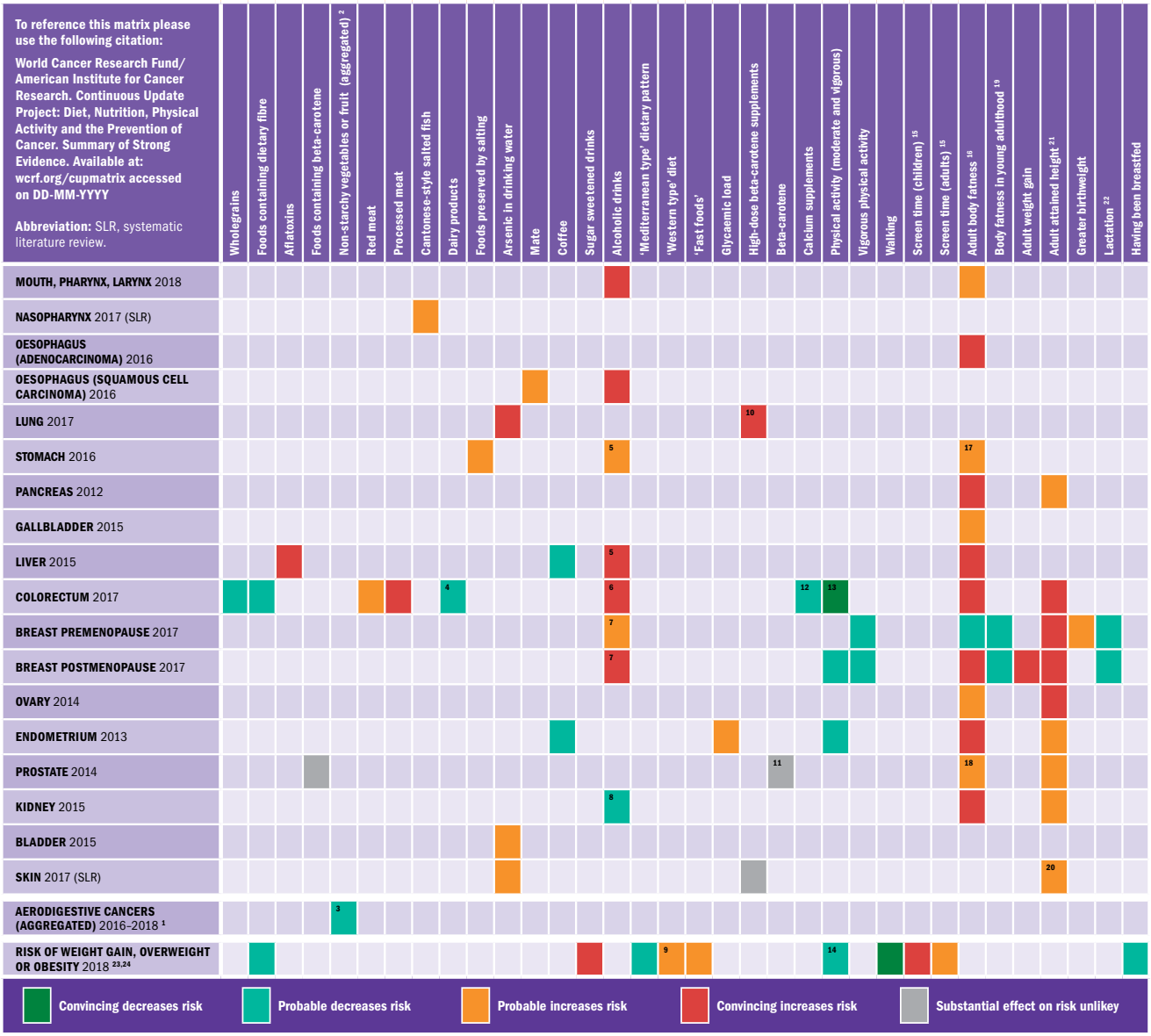
A more complete matrix, which summarises Panel judgements on all of the exposures that WCRF/AICR reviews is available from wcrf.org/matrix

SUMMARY OF STRONG EVIDENCE ON DIET, NUTRITION, PHYSICAL ACTIVITY AND THE PREVENTION OF CANCER

To reference this matrix please use the following citation:

World Cancer Research Fund/ American Institute for Cancer Research. Continuous Update Project: Diet, Nutrition, Physical Activity and the Prevention of Cancer. Summary of Strong Evidence. Available at: wcrf.org/cupmatrix accessed on DD-MM-YYYY

Abbreviation: SLR, systematic literature review.



1 Includes mouth, pharynx and larynx, nasopharynx, oesophagus (squamous cell carcinoma and adenocarcinoma), lung, stomach and colorectal cancers.
2 Aggregated exposure which contains evidence for non-starchy vegetables, fruit and citrus fruit.
3 The Panel notes that while the evidence for links between individual cancers and non-starchy vegetables or fruits is limited, the pattern of association is consistent and in the same direction, and overall the evidence is more persuasive of a protective effect.
4 Includes evidence on total dairy, milk, cheese and dietary calcium intakes.
5 Stomach and liver: Based on intakes above approximately 45 grams of ethanol per day (about 3 drinks).
6 Based on intakes above approximately 30 grams of ethanol per day (about 2 drinks per day).
7 No threshold level of intake was identified.
8 Based on intakes up to 30 grams of ethanol per day (about 2 drinks per day). There is insufficient evidence for intake greater than 30 grams per day.
9 Such diets are characterised by high intakes of free sugars, meat and dietary fat; the overall conclusion includes all these factors.
10 Evidence is from studies of high-dose supplements in smokers.
11 Includes both foods naturally containing the constituent and foods which have the constituent added and includes studies using supplements.
12 Evidence derived from studies of supplements at dose >200 milligrams per day.
13 Colon cancer only.
14 Aerobic physical activity only.
15 Screen time is a marker of sedentary behaviour.
16 Body fatness is marked by body mass index (BMI) and where possible waist circumference and waist-hip ratio.
17 Stomach cardia cancer only.
18 Advanced prostate cancer only.
19 Young women aged about 18 to 30 years; body fatness is marked by BMI.
20 Malignant melanoma only.
21 Adult attained height is unlikely to directly influence the risk of cancer. It is a marker for genetic, environmental, hormonal and nutritional factors affecting growth during the period from preconception to completion of growth in length.
22 Evidence relates to effects on the mother who is breastfeeding and not to effects on the child who is being breastfed. Relates to overall breast cancer (unspecified).
23 The factors identified as increasing or decreasing risk of weight gain, overweight or obesity do so by promoting positive energy balance (increased risk) or appropriate energy balance (decreased risk), through a complex interplay of physiological, psychological and social influences.
24 Evidence comes mostly from studies of adults but, unless there is evidence to the contrary, also apply to children (aged 5 years and over).

Cancer Prevention Recommendations – background and format

The Recommendations presented here are based on evidence that is summarised and judged in the exposure and cancer parts of this Report (see Exposure sections and CUP cancer reports). The Panel has also taken into account relevant dietary and associated recommendations designed to promote nutritional adequacy and to prevent CVD and other NCDs that have been made in other reports commissioned by United Nations agencies and other authoritative international and national organisations.

Following the Cancer Prevention Recommendations will promote a diet likely to provide adequate energy and nutrients, promote health throughout the life course, help prevent cancer and other diet-related NCDs, and help protect against nutrient deficiency. Following these Recommendations is likely to reduce intake of salt and of saturated and trans fats, which together will help prevent other diet-related NCDs. The Recommendations can inform both public policy and personal choices.

Most of the evidence available to the Panel comes from high-income countries; however, cancer is a problem worldwide. The Panel has therefore made its Recommendations with the intention that they are achievable in and appropriate to the very different circumstances and cultures that exist throughout the world.

In addition to the Cancer Prevention Recommendations presented here, the Panel emphasises the importance of not smoking and of avoiding other exposure to tobacco, excess sun and certain long-term infections that can cause cancer.

Each Recommendation is structured in the same way:

1. A short statement summarising the essence of the Recommendation and a brief explanation of the summary statement
2. A summary of the evidence from the CUP
3. A justification of the Recommendation, explaining why it was made
4. Specific quantified Goals to aid practical implementation and monitoring
5. A short discussion of the implications of the Recommendation for other NCDs
6. A brief summary of the public health and policy implications of the Recommendation – greater detail on these implications is explored in **Section 4**.

The Panel also emphasises that each Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy pattern of diet and physical activity conducive to the prevention of cancer, other NCDs and obesity.

The Panel notes that the evidence that greater body fatness is a cause of a number of cancers is particularly strong. The Recommendation 'Be a healthy weight' is therefore first.

The two Recommendations that follow ('Be physically active' and 'Eat a diet rich in wholegrains, vegetables, fruit and beans') promote positive changes that can be made to reduce the risk of cancer.

The next four Recommendations ('limit consumption of "fast foods" and other processed foods high in fat, starches or sugars', 'limit consumption of red and processed meat', 'limit consumption of sugar sweetened drinks', and 'limit alcohol consumption') focus on what to limit to reduce the risk of cancer, or of weight gain overweight and obesity, and are listed in order by foods and drinks.

The next Recommendation relates to supplements ('do not use supplements for cancer prevention').

After the eight general Recommendations are two special Recommendations – one on breastfeeding and one for cancer survivors – that are targeted at specific groups of people.

RECOMMENDATION

Be a healthy weight

Keep your weight within the healthy range[1] and avoid weight gain in adult life

- GOAL Ensure that body weight during childhood and adolescence projects towards the lower end of the healthy adult BMI range
- GOAL Keep your weight as low as you can within the healthy range throughout life
- GOAL Avoid weight gain (measured as body weight or waist circumference)[2] throughout adulthood

[1] The healthy (or, as defined by WHO, 'normal') range of BMI for adults is 18.5–24.9 kg/m^2 [43]. Different reference ranges have been proposed for Asian populations [43]. Where these ranges differ from the WHO definition, they are to be used as the guide. Further research is required to establish appropriate thresholds in other ethnic groups. The healthy range for BMI during childhood varies with age [42].

[2] WHO recommends keeping waist circumference below 94 cm (37 inches) in men and 80 cm (31.5 inches) in women (based on data from European people). These values are roughly equivalent to a BMI of around 25 kg/m^2 [44]. For Asian populations, cut-offs for waist circumferences of 90 cm (35.4 inches) for men and 80 cm (31.5 inches) for women have been proposed [44]. Further research is required to establish appropriate waist circumference values for other ethnic groups.

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that greater body fatness is a cause of many cancers. This evidence has strengthened over the last decade. Rates of overweight and obesity, in adults as well as in children, have been rising in most countries.

More detail

There is convincing evidence that greater body fatness is a cause of cancers of the oesophagus (adenocarcinoma), pancreas, liver, colorectum, breast (postmenopausal) and kidney. Greater body fatness, encompassing weight gain in adult life, is a convincing cause of endometrial cancer. Greater body fatness is also probably a cause of cancers of the mouth, pharynx and larynx, stomach (cardia), gallbladder, ovary and prostate (advanced). Weight gain in adult life is a convincing cause of postmenopausal breast cancer (see Exposures: Body fatness and weight gain).

Justification

Maintaining a healthy weight throughout life is one of the most important ways to protect against cancer. It also protects against a number of other common NCDs.

Overweight and obesity, generally assessed by various anthropometric measures including BMI and waist circumference, are now more prevalent than ever. In 2016, an estimated 1.97 billion adults and over 338 million children and adolescents were categorised as overweight or obese globally [36]. The increase in the proportion of adults categorised as obese has been observed both in low- and middle-income countries and in high-income countries.

As well as increasing the risk of many cancers assessed by the CUP, three additional cancer sites not reviewed for the CUP were reviewed by IARC who concluded greater body fatness is a cause of thyroid cancer, multiple myeloma, and meningioma [37].

For some cancers the increase in risk is seen with increasing body fatness even within the so-called 'healthy' range. Nevertheless, most benefit is to be gained by avoiding overweight and obesity. This is best achieved by ensuring healthy growth in childhood and avoiding weight gain in adult life. 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 Exposures: Body fatness and weight gain.

There is evidence that having a higher BMI may be beneficial at certain periods of the life course:

- In older people, a higher BMI (which may reflect both increased body fat and increased lean mass) is associated with reduced mortality [38]. A higher BMI is considered a marker of maintained lean mass in elderly people, and greater lean mass is associated with increased resilience and mobility as well as overall survival.
- Survival rates after cardiac events and stroke are better in people who are overweight or obese than in those with a normal BMI [39].
- This 'reverse epidemiology' for higher BMI and mortality has also been observed in patients with type 2 diabetes and those undergoing haemodialysis [40, 41].

However, having a higher BMI increases the risk of developing CVD and other chronic diseases (see **Appendix 1**), so the associations observed may be confounded by each other.

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.

Goals

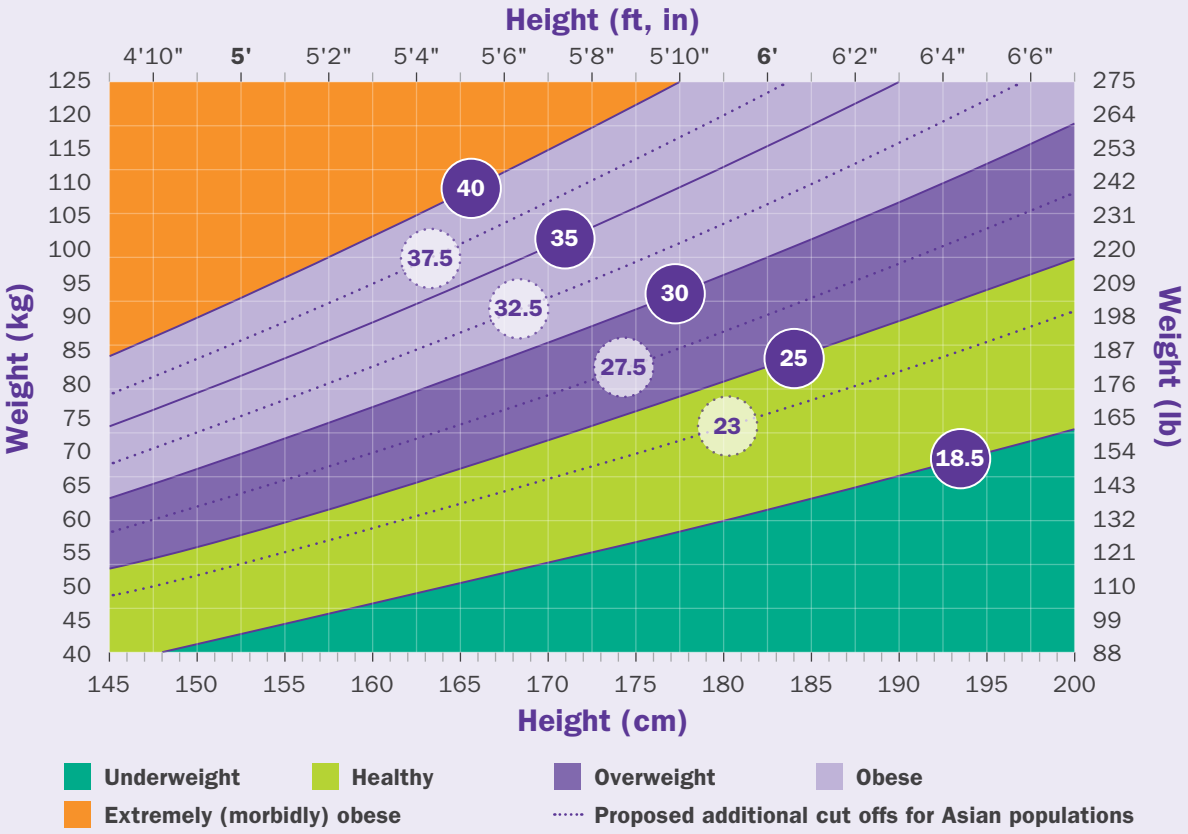
GOAL **Ensure that body weight during childhood and adolescence projects towards the lower end of the healthy adult BMI range**

GOAL **Keep your weight as low as you can within the healthy range throughout life**

These two related Goals emphasise the importance of preventing excess weight gain, overweight and obesity, beginning in childhood.

Box 4: Adult height, weight and ranges of body mass index (BMI)

Body mass index (BMI) is a simple index of weight-for-height used to classify underweight, healthy weight and overweight in adults. BMI is defined as weight in kilograms divided by the square of height in metres (kg/m^2).



It is not possible to specify a single BMI goal that applies to all people, because healthy people vary in their proportion of lean to fat tissue at any BMI. We recommend that people aim to keep their BMI as low as possible within the healthy BMI range. People who have gained weight, even within the healthy range, are advised to aim to return to their original weight.

Adults above the healthy range of BMI are recommended to lose weight to approach the healthy range; general information is available from several reliable sources, such as government guidelines and the WCRF Network, but individually tailored advice is best sought from appropriately qualified professionals.

The healthy range for BMI during childhood varies with age [42]. The healthy range of BMI for adults, as defined by the World Health Organization, is between 18.5 and 24.9 kg/m^2 [43].

Because the relationship between BMI and body composition varies between ethnic groups, different reference ranges have been proposed for Asian populations [43].

Where these ranges differ from the World Health Organization (WHO) definition, they are to be used as a guide. See **Box 4**. Further research is required to establish appropriate thresholds in other ethnic groups.

GOAL **Avoid weight gain (measured as body weight or waist circumference) throughout adulthood**

There may be adverse effects specifically from gaining weight during adulthood (see Exposures: Body fatness and weight gain), and so the Panel recommends maintaining weight within the healthy range throughout adult life.

The WHO reference values (the value that waist circumference should be kept below, based on data from European men and women) for waist circumferences of 94 cm (37 inches) in men and 80 cm (31.5 inches) in women (on a population basis) are roughly equivalent to a BMI of about 25 kg/m^2, whereas waist circumferences of 102 cm (40.2 inches) in men and 88 cm (34.6 inches) in women are equivalent to a BMI of about 30 kg/m^2 [44]. For Asian populations, cut-offs for waist circumferences of 90 cm (35.4 inches) for men and 80 cm (31.5 inches) for women have been proposed [44]. As for thresholds for BMI, further research is required to establish appropriate waist circumference values for other ethnic groups.

This overall Recommendation can best be achieved by maintaining energy balance throughout life by:

- being physically active
- eating a diet rich in wholegrains, vegetables, fruit and pulses such as beans
- limiting consumption of 'fast foods' and other processed foods high in fat, starches or sugars
- limiting consumption of sugar sweetened drinks.

See the **Recommendations, 'be physically active'**, **'eat a diet rich in wholegrains, vegetables, fruit and beans'**, **'limit consumption of 'fast foods' and other processed foods'**, **'limit consumption of red and processed meat'** and **'limit consumption of sugar sweetened beverages'**; also see Energy balance and body fatness.

Implications for other diseases

It is well established that greater body fatness has a causal role in the development of several other disorders and diseases, such as type 2 diabetes, dyslipidaemia, hypertension, stroke and CHD, as well as digestive and musculoskeletal disorders [45–49]. People with obesity often develop several of these disorders or diseases, leading to multiple comorbidities (see **Appendix 1**).

Public health and policy implications

Globally, the prevalence of overweight and obesity is high and in most countries it is rising [36].

A whole-of-government, whole-of-society approach is necessary to create environments for people and communities that are conducive to being a healthy weight.

A comprehensive package of policies is needed to enable people to achieve and maintain a healthy weight, including policies that influence the food environment, food system, built environment and behaviour change communication across the life course. These policies can also help contribute to a sustainable ecological environment. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Body fatness and weight gain

Energy balance and body fatness

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

Be physically active

Be physically active as part of everyday life – walk more and sit less

GOAL Be at least moderately physically active[1], and follow or exceed national guidelines

GOAL Limit sedentary habits

[1] Moderate physical activity increases heart rate to about 60 to 75 per cent of its maximum.

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that physical activity protects against cancers of the colon, breast and endometrium. There is also strong evidence that physical activity helps prevent excess weight gain and obesity. Therefore, physical activity may also indirectly contribute to a reduced risk of obesity-related cancers.

More detail

There is convincing evidence that physical activity (of moderate or vigorous intensity) protects against colon cancer. Physical activity (of moderate or vigorous intensity) probably protects against postmenopausal breast cancer and endometrial cancer. Physical activity at a vigorous intensity probably protects against premenopausal breast cancer (see Exposures: Physical activity).

There is convincing evidence that walking protects against weight gain, overweight and obesity. Aerobic physical activity probably protects against weight gain, overweight and obesity. There is also convincing evidence that screen time (such as sitting watching television, occupational screen time and using other electronic devices), which is a marker of sedentary living, is a cause of weight gain, overweight and obesity in children. Greater screen time is also probably a cause of weight gain, overweight and obesity in adults (see Energy balance and body fatness). There is strong evidence that greater body fatness is a cause of many cancers (see Exposures: Body fatness and weight gain).

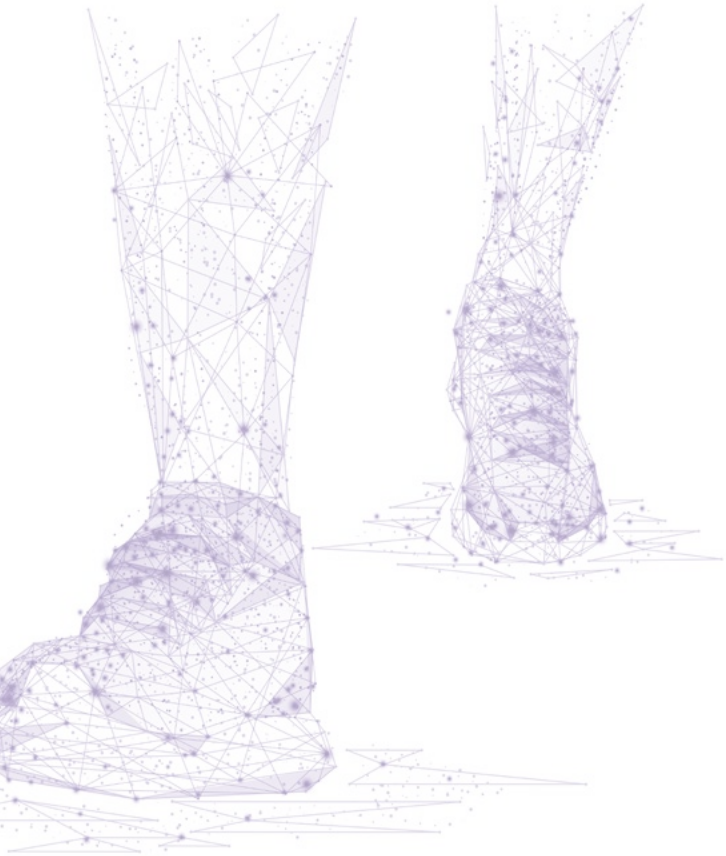
Justification

Lack of physical activity and sedentary lifestyles are globally widespread.

In most parts of the world, levels of physical activity are insufficient for optimal health [50]. Sedentary ways of life have become common in high-income countries since the second half of the 20th century and have subsequently also become widespread in most populations around the world [51].

Because physical activity contributes to the prevention of excess weight gain, it may reduce the risk of obesity-related cancers. Further details of evidence and judgements can be found in Exposures: Body fatness and weight gain and Exposures: Physical activity.

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.



Goals

GOAL **Be at least moderately physically active, and follow or exceed national guidelines**

This Recommendation derives from the evidence on both risk factors for cancer and risk factors for overweight and obesity, which are a cause of many cancers.

People whose work is sedentary need to take special care to build some physical activity into their everyday lives. WHO advises adults to be active daily and recommends them to engage in at least 150 minutes of moderate-intensity aerobic physical activity or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate and vigorous intensity activity [52]. The Panel considers this the minimum amount necessary for cardio-metabolic health. For cancer prevention, it is likely the greater the amount of physical activity the greater the benefit. To have a significant impact on weight control, higher levels are required (45 to 60 minutes of moderate-intensity physical activity per day) [53]. Children and young people aged 5 to 17 need to accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily. Amounts of physical activity greater than 60 minutes provide additional health benefits [54].

Examples of moderate-intensity activities include walking, cycling, household chores, gardening and certain occupations (physically active work), as well as recreational activities (for example, swimming and dancing). Examples of vigorous-intensity activities include running, fast swimming, fast cycling, aerobics and some team sports.

Physical activity is also important for older people who are advised to establish being physically active as a daily habit. Active living in early and mid-life can help lead to healthy ageing [55].

GOAL Limit sedentary habits

Watching television or screens, including occupational screen time, and using other types of electronic devices, such as playing games consoles, are forms of sedentary behaviour. In some countries, children commonly spend more than 3 hours per day using such devices, through which they are also often exposed to intensive marketing of highly processed food and drink high in fat, refined starches or sugars [56, 57]. In addition, screen time may also be associated with consumption of energy-dense snacks and drinks [58–61].

Many occupations involve prolonged periods of sitting. Both adults and children are advised to minimise the amount of time spent being sedentary for extended periods.

Although evidence for sedentary behaviours as a risk for cancer (for example, endometrial cancer), and as a determinant of weight is still emerging, it is likely that extended periods of sitting may promote weight gain and so indirectly increase cancer risk.

Implications for other diseases

Regular physical activity of at least moderate intensity decreases the risk of all-cause mortality [62], CHD [63], high blood pressure [64], stroke [65], type 2 diabetes [63], metabolic syndrome [66] and depression [67] (see **Appendix 1**). Regular weight-bearing and muscle-strengthening exercise has several documented health benefits, including promoting bone health and reducing blood pressure [68] (see **Appendix 1**).

Public health and policy implications

In most parts of the world, levels of physical activity are insufficient for optimal health [50].

A whole-of-government, whole-of-society approach is necessary to create environments for people and communities that are conducive to being more physically active and less sedentary.

A comprehensive package of policies is needed to promote and support physical activity, including policies that influence the food environment, the food system, the built environment and behaviour change communication across the life course. These policies can also help contribute to a sustainable ecological environment. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Physical activity

Energy balance and body fatness

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

Eat a diet rich in wholegrains, vegetables, fruit and beans

Make wholegrains, vegetables, fruit, and pulses (legumes) such as beans and lentils a major part of your usual daily diet

- GOAL Consume a diet that provides at least 30 grams per day of fibre[1] from food sources
- GOAL Include in most meals foods containing wholegrains, non-starchy vegetables, fruit and pulses (legumes) such as beans and lentils
- GOAL Eat a diet high in all types of plant foods including at least five portions or servings (at least 400 grams or 15 ounces in total) of a variety of non-starchy vegetables and fruit every day
- GOAL If you eat starchy roots and tubers as staple foods, eat non-starchy vegetables, fruit and pulses (legumes) regularly too if possible

[1] Measured by the AOAC method.

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that consumption of wholegrains protects against colorectal cancer and consumption of foods containing dietary fibre protects against colorectal cancer and against weight gain, overweight and obesity. There is limited evidence suggesting that consumption of non-starchy vegetables and fruit, and some of their constituents, reduces the risk of a range of cancers and protects against weight gain, overweight and obesity.

Although the evidence for links between individual cancers and consumption of non-starchy vegetables or fruit or their constituents is limited, the pattern of association and the direction of effect are both consistent, and overall the evidence is more persuasive of a protective effect.

The evidence suggests the greatest risk is for people who consume no or low levels of non-starchy vegetables or fruit, with a less clear tendency for increasing benefit with greater consumption.

In addition, dietary patterns that are linked to a lower risk of cancer consistently feature high consumption of these foods.

More detail

Consumption of wholegrains and consumption of foods containing dietary fibre probably protect against colorectal cancer.

There is limited evidence suggesting that consumption of non-starchy vegetables decreases the risk of developing cancers of the mouth, pharynx and larynx, nasopharynx, oesophagus (adenocarcinoma and squamous cell carcinoma), lung (in current and former smokers), colorectum, breast (oestrogen receptor negative [ER-] – menopausal status unspecified) and bladder.

There is limited evidence suggesting that consumption of fruit decreases the risk of developing cancers of the oesophagus (squamous cell carcinoma), lung (in current and former smokers), stomach, colorectum and bladder. There is also limited evidence suggesting that consumption of citrus fruit decreases the risk of developing stomach cardia cancer.

There is limited evidence suggesting that consumption of foods containing carotenoids reduces the risk of developing lung cancer and breast cancer (menopausal status unspecified), that consumption of foods containing beta-carotene reduces the risk of developing lung cancer, that consumption of foods containing vitamin C reduces the risk of developing lung cancer (in current smokers) and colon cancer, and that consumption of foods containing isoflavones reduces the risk of developing lung cancer (in people who have never smoked).

Taking into account the consistent pattern of association and direction of effect, the Panel judges that, overall, greater consumption of non-starchy vegetables or fruit probably protects against a number of aerodigestive cancers and some other cancers. In particular, people need to avoid very low intakes of these foods.

Consumption of foods containing dietary fibre probably protects against weight gain, overweight and obesity. There is also limited evidence suggesting that consumption of wholegrains and combined consumption of non-starchy vegetables and fruit decrease the risk of weight gain, overweight and obesity (see Exposures: Wholegrains, vegetables and fruit and Energy balance and body fatness).

The evidence is based on records of intakes of non-starchy vegetables and fruit, and of foods containing dietary fibre. Although researchers have identified some plausible biological mechanisms that could explain how various components of these foods might influence the risk of cancer, it is not currently possible to confidently ascribe a protective effect to any specific component. Recommendations are therefore for the whole food, which reflects what people actually consume (see the **Recommendation 'do not use supplements for cancer prevention'**).

Justification

An integrated approach to considering the evidence shows that most diets that are protective against cancer are rich in foods of plant origin.

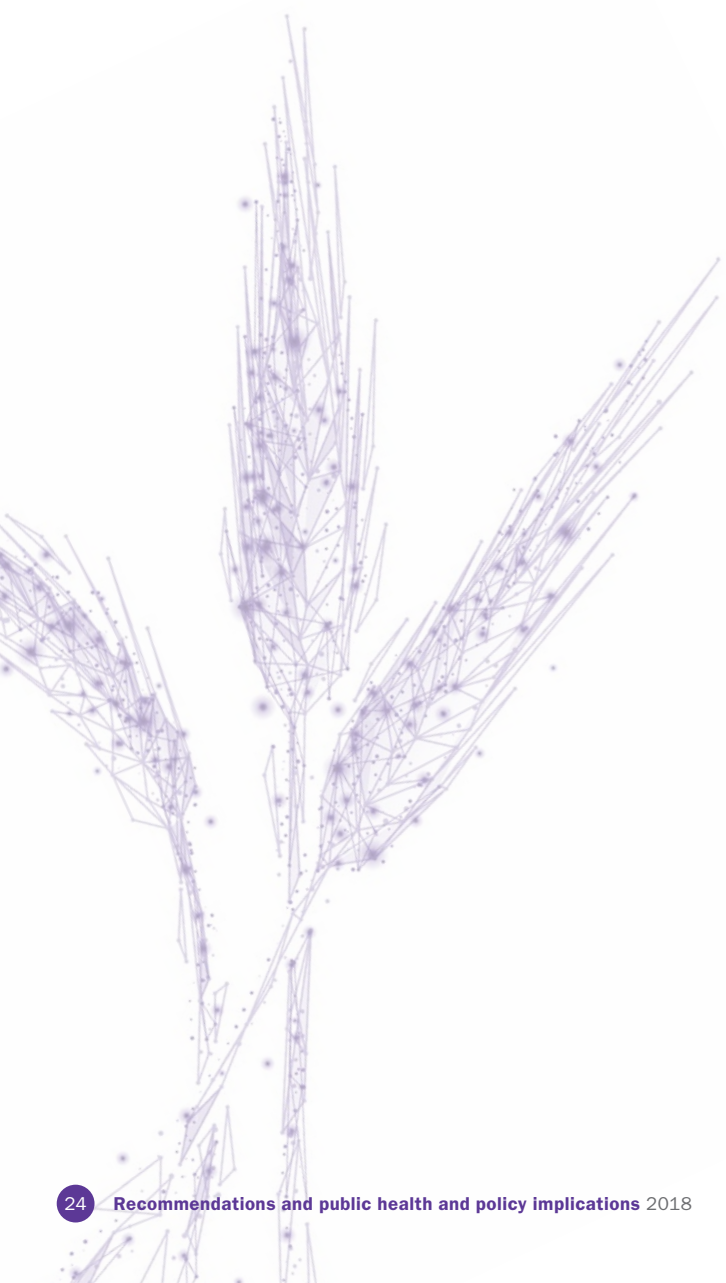
Relatively unprocessed foods of plant origin are rich in nutrients and dietary fibre. Higher consumption of these foods instead of processed foods high in fat, refined starches and sugars[1] would mean a diet is higher in essential nutrients and more effective for regulating energy intake relative to energy expenditure. This could protect against weight gain, overweight and obesity and therefore protect against obesity-related cancers. Further details of evidence and judgements can be found in Energy balance and body fatness and the **Recommendation 'limit consumption of "fast food"'**.

[1] Processed foods high in refined starches include products made from white flour such as bread, pasta and pizza; processed foods that are high in fat, starches or sugars include cakes, pastries, biscuits (cookies), other bakery foods and confectionery (candy).

This Recommendation on wholegrains, vegetables, fruit and beans is designed to ensure that these foods become a feature of most meals.

Wholegrains, non-starchy vegetables, fruit and beans are a consistent feature of diets associated with lower risk of cancer and other diet-related NCDs, as well as obesity [69]. The evidence suggests that the greatest benefit may be for people who consume no or low levels of non-starchy vegetables and fruit who increase their consumption.

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.



Goals

GOAL **Consume a diet that provides at least 30 grams per day of fibre from food sources**

GOAL **Include in most meals foods containing wholegrains, non-starchy vegetables, fruit and pulses (legumes) such as beans and lentils**

GOAL **Eat a diet high in all types of plant foods including at least five portions or servings (at least 400 grams or 15 ounces in total) of a variety of non-starchy vegetables and fruit every day**

The Panel emphasises the importance of consuming a diet that provides at least 30 grams per day of fibre (equivalent to about 20 to 24 grams of non-starch polysaccharides), made up from a range of foods of plant origin, including wholegrains and non-starchy vegetables and fruit of different colours (for example, red, green, yellow, white, purple and orange).

Examples of wholegrains include brown rice, wheats, oats, barley and rye. Examples of non-starchy vegetables include green leafy vegetables, broccoli, okra, aubergine (eggplant) and bok choy, but not, for instance, potatoes, yams or cassava. For the purposes of this Recommendation, non-starchy roots and tubers such as carrots, artichokes, celeriac (celery root), swede (rutabaga) and turnips are considered to be non-starchy vegetables.

One portion of non-starchy vegetables or fruit is approximately 80 grams or 3 ounces. If consuming the recommended amount of vegetables and fruit stated above, consumption will be at least 400 grams or 15 ounces per day.

GOAL

If you eat starchy roots and tubers as staple foods, eat non-starchy vegetables, fruit and pulses (legumes) regularly too if possible

In many parts of the world, traditional food systems are based on roots or tubers such as cassava, sweet potatoes, yams and taro. Where appropriate, it is advisable to protect traditional food systems – in addition to their cultural value, and their suitability to local climate and terrain, they are often nutritionally superior to the diets that tend to displace them. However, monotonous traditional diets, especially those that contain only small amounts of non-starchy vegetables, fruit and pulses (legumes), are likely to be low in essential micronutrients and thereby increase susceptibility to some cancers.

The Panel emphasises the importance of consuming wholegrains, non-starchy vegetables, fruit 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, and recommends these, and not foods of animal origin, be the basis of a usual daily diet.

Implications for other diseases

The Goals and the Recommendation on wholegrains, vegetables, fruit and beans are based on evidence on cancer and are supported by evidence on mortality (both cardiovascular and non-cardiovascular mortality) and type 2 diabetes [63, 70, 71]. Many other, broadly similar recommendations have been issued by a range of authoritative international and national organisations (see **Appendix 1**).

[1] Measured by the American Association of Analytical Chemists (AOAC) method

Public health and policy implications

A whole-of-government, whole-of-society approach is necessary to create environments for people and communities that are conducive to eating a diet rich in wholegrains, vegetables, fruit and beans.

A comprehensive package of policies is needed to enable and encourage people to eat enough wholegrains, vegetables, fruit and beans, including policies that influence the food environment, the food system and behaviour change communication across the life course. Globally, food systems that are directed towards foods of plant rather than animal origin are more likely to contribute to a sustainable ecological environment. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Body fatness and weight gain

Exposures: Wholegrains, vegetables and fruit

Energy balance and body fatness

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

Limit consumption of ‘fast foods’ and other processed foods high in fat, starches or sugars

Limiting these foods helps control calorie intake and maintain a healthy weight

GOAL Limit consumption of processed foods high in fat, starches or sugars – including ‘fast foods’[1]; many pre-prepared dishes, snacks, bakery foods and desserts; and confectionery (candy)

[1] ‘Fast foods’ are readily available convenience foods that tend to be energy dense and are often consumed frequently and in large portions.

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that diets containing greater amounts of ‘fast foods’ and other processed foods high in fat, starches or sugars are a cause of weight gain, overweight and obesity by increasing the risk of excess energy intake relative to expenditure. Greater body fatness is a cause of many cancers. Furthermore, glycaemic load probably causes endometrial cancer independently of its effect on body weight.

More detail

Consumption of ‘fast food’ (see **Box 5**) and consumption of a ‘Western type’ diet are probably causes of weight gain, overweight and obesity (see Energy balance and body fatness). There is strong evidence that greater body fatness is a cause of many cancers (see Exposures: Body fatness and weight gain). Glycaemic load (see **Box 6**) probably causes endometrial cancer (Exposures: Other dietary exposures).

Sugar sweetened drinks are considered in a separate Recommendation.

Justification

Consumption of diets containing large amounts of ‘fast foods’ and other processed foods high in fat, starches or sugars is increasing worldwide and is contributing to the global increase in overweight and obesity and therefore to obesity-related cancers.

Processed foods high in fat, starches or sugars embody a cluster of characteristics that encourage excess energy consumption, for example, by being highly palatable, high in energy, affordable, easy to access and convenient to store. The determinants of the environments in which people make choices about food and activity are discussed in **Section 4**.

Box 5: 'Fast foods'

'Fast foods' are readily available convenience foods that tend to be energy dense and are often consumed frequently and in large portions.

Most of the evidence on 'fast foods' is from studies of foods such as burgers, fried chicken pieces, chips (French fries) and high-calorie drinks (containing sugars, such as cola, or fat, such as shakes), as typically served in international franchise outlets. Many other foods can also be prepared quickly, but the speed of preparation is not the important factor, even though it is characteristic of this group of foods.

Other processed foods high in fat, starches or sugars

Most foods undergo some form of processing before consumption. More highly processed foods have generally undergone industrial processing and may sometimes be unrecognisable from their original plant or animal source [72]. They are often higher in energy and lower in micronutrients.

This Recommendation refers to processed foods high in fat, starches or sugars. These foods include

- potato products such as chips (French fries) and crisps (chips)
- products made from white flour such as bread, pasta and pizza
- cakes, pastries, biscuits (cookies) and other bakery foods
- confectionery (candy).

'Western type' diet

'Western type' diets are characterised by a high amount of free sugars, meat and fat.

Box 6: Glycaemic index and glycaemic load

The glycaemic index (GI) is a measure of the increase in blood glucose (and insulin) after consumption of a standard amount of a food under controlled conditions. The glycaemic load (GL) of a food takes into account the amount of that food consumed; that of a diet takes into account the calculated aggregate of the glycaemic loads of the foods constituting that diet. Higher glycaemic load may promote fat deposition due to greater insulin secretion.

The calculated GI of a mixed meal or whole diet has been shown to correlate with the observed GI following a mixed meal, though this is not a universal finding. Although the concept of GI has been controversial, the GI and GL of diets have predicted risks of type 2 diabetes and CHD and related biomarkers, independent of dietary fibre intake [73, 74]. Nevertheless, GL and GI are just two aspects of foods or diets and viewed alone cannot be taken to represent their 'healthiness' or otherwise.

Overweight and obesity are at the highest levels ever seen globally (see Energy balance and body fatness and the Recommendation 'be a healthy weight'). Increases in levels are particularly evident in middle-income countries where 'fast foods' and other processed foods high in fat, starches or sugars are increasingly available, as physical activity levels are declining [12]. This is a feature of the 'nutrition transition' that accompanies economic development (see **Section 4**).

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.

Goal

GOAL **Limit consumption of processed foods high in fat, starches or sugars – including 'fast foods'; many pre-prepared dishes, snacks, bakery foods and desserts; and confectionery (candy)**

This Recommendation does not imply that all foods high in fat need to be avoided. Some, such as certain oils of plant origin, nuts and seeds, are important sources of nutrients. Their consumption has not been linked with weight gain, and by their nature they tend to be consumed in smaller portions.

Implications for other diseases

Limited intake of processed foods high in fat, starches or sugars is recommended by many other organisations to reduce the risk of several NCDs [75].

Limiting intake of 'fast foods' and other processed foods high in fat, starches or sugars reduces the risk of weight gain, overweight and obesity. Overweight and obesity are common risk factors for several other disorders and diseases, such as CVD, type 2 diabetes, hypertension and stroke [76] (see **Appendix 1**).

Public health and policy implications

The increasing availability, affordability and acceptability of 'fast foods' and other processed foods high in fat, starches or sugars is contributing to rising rates of overweight and obesity worldwide [12].

A whole-of-government, whole-of-society approach is necessary to create environments for people and communities that are conducive to limiting consumption of 'fast foods' and other processed foods high in fat, starches or sugars and to consume healthy diets consistent with the Cancer Prevention Recommendations.

A comprehensive package of policies is needed to limit the availability, affordability and acceptability of 'fast foods' and other processed foods, including policies that restrict marketing of such foods, especially to children. Policies are needed that influence the food environment, the food system and behaviour change communication across the life course. These policies can also help contribute to a sustainable ecological environment. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Body fatness and weight gain

Energy balance and body fatness

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

Limit consumption of red and processed meat

Eat no more than moderate amounts of red meat[1], such as beef, pork and lamb. Eat little, if any, processed meat[2]

GOAL **If you eat red meat, limit consumption to no more than about three portions per week. Three portions is equivalent to about 350 to 500 grams (about 12 to 18 ounces) cooked weight of red meat.[3] Consume very little, if any, processed meat**

[1] The term 'red meat' refers to all types of mammalian muscle meat, such as beef, veal, pork, lamb, mutton, horse and goat.

[2] The term 'processed meat' refers to meat that has been transformed through salting, curing, fermentation, smoking or other processes to enhance flavour or improve preservation.

[3] 500 grams of cooked red meat is roughly equivalent to 700–750 grams of raw meat, but the exact conversion depends on the cut of meat, the proportions of lean meat and fat, and the method and degree of cooking.

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that consumption of red meat and consumption of processed meat are both causes of colorectal cancer.

More detail

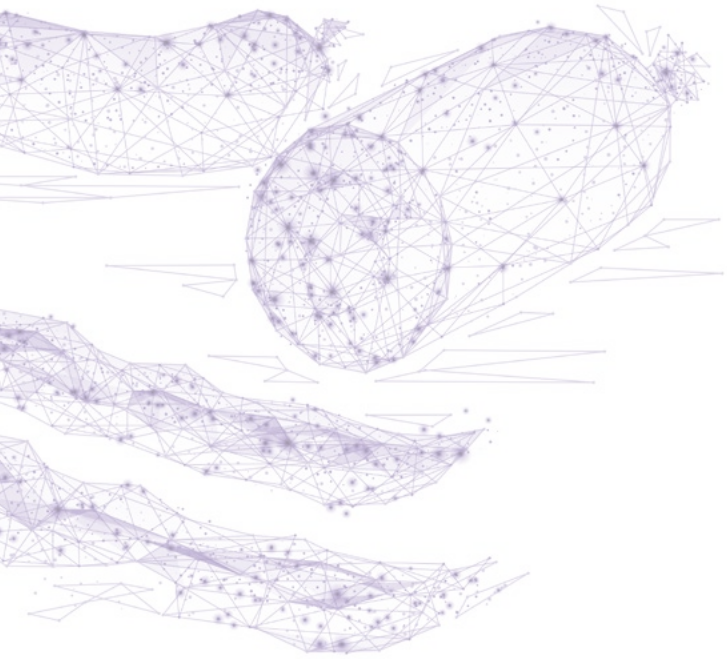
There is convincing evidence that consumption of processed meat is a cause of colorectal cancer. Consumption of red meat is probably a cause of colorectal cancer (see Exposures: Meat, fish and dairy products).

Justification

An integrated approach to the evidence shows that diets that reduce the risk of cancer and other NCDs contain no more than modest amounts of red meat and little or no processed meat.

The term 'red meat' refers to all types of mammalian muscle meat, such as beef, veal, pork, lamb, mutton, horse and goat.

The term 'processed meat' refers to meat that has been transformed through salting, curing, fermentation, smoking or other processes to enhance flavour or improve preservation. Depending on food preparation practices, processed meat can include ham, salami, bacon and some sausages such as frankfurters and chorizo. Most processed meats contain pork or beef but may also contain other red meats, poultry, offal or meat by-products such as blood. Sausages may sometimes, though not always, fall within the definition of processed meat.



Red meat is a good source of protein, iron and other micronutrients. For those who consume it, lean rather than fatty cuts of red meat are preferred.

It is not necessary to consume red meat in order to maintain adequate nutritional status [77]. People who do not consume foods from animal sources can obtain adequate protein from a mixture of pulses (legumes) and cereals (grains). Iron is present in many plant foods, though it is less bioavailable than that in meat.

For those who avoid red meat but eat other foods of animal origin, poultry and fish are valuable substitutes for red meat. Eggs and dairy are also valuable sources of protein and micronutrients.

Simply removing red meat from an otherwise typical 'Western type' diet without consideration of the overall balance of the diet may compromise its nutritional adequacy.

It is best to avoid processed meat as much as possible, as it is generally energy dense and can contain high levels of salt. What is more, some of the methods of preservation used to create processed meat (which include smoking, curing and salting, and the addition of chemical preservatives) are known to generate carcinogens.

Improved access to refrigeration globally has reduced the use of traditional methods of preserving meat, such as salting, smoking, curing and pickling. However, opportunities to use refrigeration to preserve fresh meat remain limited in some countries, where processed meat might be an important source of protein and iron.

High consumers of red meat and processed meat who reduce their intakes are expected to gain the greatest benefit from following this Recommendation. Further details of evidence and judgements can be found in Exposures: Meat, fish and dairy products.

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.

Goal

GOAL **If you eat red meat, limit consumption to no more than about three portions per week. Three portions is equivalent to about 350 to 500 grams (about 12 to 18 ounces) cooked weight of red meat. Consume very little, if any, processed meat**

The Panel emphasises that the Recommendation is not to completely avoid eating meat. Meat can be a valuable source of nutrients, in particular protein, iron, zinc and vitamin B12. However, eating meat is not an essential part of a healthy diet. People who choose to eat meat-free diets can obtain adequate amounts of these nutrients through careful food selection.

The guidance on the maximum amount of red meat to eat is for the weight of the meat as eaten. As a rough conversion, 500 grams of cooked red meat is about equivalent to 700 to 750 grams of raw meat. More specific guidance is not possible, because the exact

conversion depends on the cut of meat, the proportions of lean meat and fat, and the method and degree of cooking.

The Recommendation on consumption of red meat identifies the level of consumption that the Panel judges to provide a balance between the advantages of consuming red meat (as a source of essential macro- and micronutrients) and the disadvantages of consuming red meat (an increased risk of colorectal cancer). This Recommendation is given in terms of weekly consumption, as red meat need not be consumed on a daily basis.

The evidence on processed meat is even more clear-cut. The data show that no level of intake can confidently be associated with a lack of risk.

A diet low in red and processed meat does not have to exclude eggs, dairy, poultry or fish, and it allows for higher consumption of wholegrains, non-starchy vegetables, fruit and pulses (legumes) such as beans and lentils.

Implications for other diseases

A strong body of scientific evidence links consumption of red and processed meat with risk of death from CVD [78] and risk of stroke [79] and type 2 diabetes [80].

Mostly prospective cohort studies but also randomised controlled trials have shown that eating patterns that include a lower intake of meat, processed meat and processed poultry are associated with reduced risk of CVD in adults [75]. Moderate evidence indicates that these eating patterns are also associated with reduced risk of type 2 diabetes [75].

Processed meats are often high in salt, which can increase the risk of high blood pressure and CVD mortality [81].

Meat is an important source of iron. A mixed diet containing a maximum of 350 to 500 grams a week of red meat would have little effect on the proportion of adults with iron intakes below recommended levels [82]. If unbalanced, vegetarian diets may increase the risk of iron deficiency.

Public health and policy implications

A whole-of-government, whole-of-society approach is necessary to create environments for people and communities that are conducive to limiting consumption of red meat and processed meat.

A comprehensive package of policies is needed to support people to consume diversified diets including limited red meat and little, if any, processed meat, including policies that influence the food environment, the food system and behaviour change communication across the life course. Globally, food systems that are directed towards foods of plant rather than animal origin are more likely to contribute to a sustainable ecological environment. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Meat, fish and dairy products

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

Limit consumption of sugar sweetened drinks

Drink mostly water and unsweetened drinks

GOAL **Do not consume sugar sweetened drinks[1]**

[1] Sugar sweetened drinks are defined here as liquids that are sweetened by adding free sugars, such as sucrose, high fructose corn syrup and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrate. This includes, among others, sodas, sports drinks, energy drinks, sweetened waters, cordials, barley water, and coffee- and tea-based beverages with sugars or syrups added. This does not include versions of these drinks which are 'sugar free' or sweetened only with artificial sweeteners.

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that regular consumption of sugar sweetened drinks is a cause of weight gain, overweight and obesity, by increasing the risk of excess energy intake relative to expenditure. Greater body fatness is a cause of many cancers.

More detail

There is convincing evidence that consumption of sugar sweetened drinks is a cause of weight gain, overweight and obesity in both children and adults, especially when consumed frequently or in large portions. Sugar sweetened drinks do this by promoting excess energy intake relative to energy expenditure (see Energy balance and body fatness).

There is strong evidence that greater body fatness is a cause of many cancers: mouth, pharynx and larynx, oesophagus (adenocarcinoma), stomach (cardia), pancreas, gallbladder, liver, colorectum, breast (postmenopausal), ovary, endometrium, prostate (advanced) and kidney (see Exposures: Body fatness and weight gain).

Justification

Consumption of sugar sweetened drinks is increasing in many countries worldwide and is contributing to the global increase in obesity, which increases the risk of many cancers.

In recent years the greatest increases in consumption of sugar sweetened drinks have been observed in low- and middle-income countries [83]. Although sales of sugar sweetened drinks have decreased in many high-income countries over the same period, total consumption has remained high [83].

Sugar sweetened drinks provide energy but may not induce satiety and can promote overconsumption of energy and thus weight gain [84]. This effect is compounded at low levels of physical activity. Further details of evidence and judgements can be found in Energy balance and body fatness.

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.

Goal

GOAL **Do not consume sugar sweetened drinks**

To maintain adequate hydration, it is best to drink water or unsweetened drinks, such as tea (*Camellia sinensis*) or coffee without added sugar. There is evidence that coffee probably protects against liver and endometrial cancers (see **Section 3** and Exposures: Non-alcoholic drinks).

Coffee and tea both contain caffeine. For healthy adults, the maximum safe daily intake of caffeine from all sources recommended by the European Food Safety Authority [85] is 400 milligrams per day (approximately four cups of brewed coffee). The limit is lower in pregnancy.

Do not consume fruit juices in large quantities, as even with no added sugar they are likely to promote weight gain in a similar way to sugar sweetened drinks. Most national guidelines now recommend limiting intake of fruit juice.

There is no strong evidence in humans to suggest that artificially sweetened drinks with minimal energy content, such as diet sodas, are a cause of cancer (see Exposures: Non-alcoholic drinks). The evidence that artificially sweetened drinks help prevent weight gain, overweight and obesity is not consistent [86] (see Energy balance and body fatness literature review 2017).

The Panel therefore recommends limiting intake of sugar sweetened drinks and replacing with water or unsweetened drinks. The available evidence is insufficient to make a recommendation regarding artificially sweetened drinks.

Implications for other diseases

There is strong evidence that regular consumption of sugar sweetened drinks increases the risk of weight gain, overweight and obesity (see Energy balance and body fatness). Greater body fatness is a common risk factor for many other diseases and disorders, including CVD and type 2 diabetes (see the **Recommendation 'be a healthy weight'** and **Appendix 1**).

There is some evidence to suggest that regular consumption of sugar sweetened drinks increases the risk of type 2 diabetes independently of its effects on adiposity [87].

Consumption of sugar sweetened drinks is a major cause of dental caries and impaired oral health, particularly in children [88].

Public health and policy implications

The consumption of sugar sweetened drinks has rapidly increased in many parts of the world, especially in low- and middle-income countries, contributing to rising rates of overweight and obesity [83].

A whole-of-government, whole-of-society approach is necessary to create environments for people and communities that are conducive to limiting consumption of sugar sweetened drinks.

A comprehensive package of policies is needed to limit the availability, affordability and acceptability of sugar sweetened drinks, including marketing restrictions and taxes on sugar sweetened drinks, and securing access to clean water (this is of particular relevance to school settings). Policies are needed that influence the food environment, the food system and behaviour change communication across the life course. These policies can also help contribute to a sustainable ecological environment. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Body fatness and weight gain

Energy balance and body fatness

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

Limit alcohol consumption

For cancer prevention, it's best not to drink alcohol

GOAL For cancer prevention, it's best not to drink alcohol

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that drinking alcohol is a cause of many cancers.

More detail

There is convincing evidence that consumption of alcoholic drinks is a cause of cancers of the mouth, pharynx, and larynx, oesophagus (squamous cell carcinoma), liver, colorectum and breast (postmenopause). Consumption of alcoholic drinks is also probably a cause of stomach cancer and premenopausal breast cancer. Consumption of alcoholic drinks probably protects against kidney cancer (see Exposures: Alcoholic drinks).

Justification

The evidence on cancer justifies the Recommendation not to drink alcoholic drinks.

Overall, the evidence from the CUP shows that consuming alcoholic drinks is a cause of many cancers. The finding that drinking alcohol probably protects against kidney cancer (at least, up to 30 grams per day or 2 drinks per day) is far outweighed by the increased risk for other cancers.

The evidence shows that alcoholic drinks of all types have a similar impact on cancer risk. This Recommendation therefore covers all types of alcoholic drinks, whether beers, wines, spirits (liquors) or any other drinks, as well as other alcohol sources.

The important factor is the amount of alcohol (ethanol) consumed. Even small amounts of alcoholic drinks can increase the risk of several cancers. There is no threshold for the level of consumption below which there is no increase in the risk of at least some cancers. Further details of evidence and judgements can be found in the Exposures: Alcoholic drinks.

Although there are uncertainties about the effects of alcohol on non-cancer outcomes at moderate levels of consumption, there is no justification for recommending drinking alcohol for non-cancer health outcomes.

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

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.

Goal

GOAL **For cancer prevention, it's best not to drink alcohol**

If you do consume alcoholic drinks, do not exceed your national guidelines.

Implications for other diseases

Results of prospective studies suggest people who consume small amounts of alcohol may have lower risks of CHD and all-cause mortality than non-drinkers, though any potential protective effect is seen at low levels of consumption (about one unit a day) and is limited to specific population groups [89].

Heavy alcohol use is overwhelmingly detrimentally related to many CVDs, including hypertensive disease, haemorrhagic stroke and atrial fibrillation [90]. Alcohol consumption is associated with various kinds of liver disease, with fatty liver, alcoholic hepatitis and cirrhosis being the most common. It has also been associated with an increased risk of pancreatitis [90] (see **Appendix 1**).

Although there are uncertainties about the effects of alcohol on non-cancer outcomes at moderate levels of consumption, drinking alcohol is not recommended for any health benefit.

Public health and policy implications

A whole-of-government, whole-of-society approach is necessary to create environments for people and communities that are conducive to limiting alcohol consumption.

A comprehensive package of policies is needed to reduce alcohol consumption at a population level, including policies that influence the availability, affordability and marketing of alcoholic beverages. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Alcoholic drinks

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

Do not use supplements for cancer prevention

Aim to meet nutritional needs through diet alone

GOAL **High-dose dietary supplements[1] are not recommended for cancer prevention – aim to meet nutritional needs through diet alone**

[1] A dietary supplement is a product intended for ingestion that contains a 'dietary ingredient' intended to achieve levels of consumption of micronutrients or other food components beyond what is usually achievable through diet alone.

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence from randomised controlled trials that high-dose beta-carotene supplements may increase the risk of lung cancer in some people. There is no strong evidence that dietary supplements, apart from calcium for colorectal cancer, can reduce cancer risk.

More detail

There is convincing evidence that consumption of high-dose beta-carotene supplements is a cause of lung cancer in current and former smokers. Consuming beta-carotene supplements or foods containing beta-carotene is unlikely to have a substantial effect on the risk of prostate cancer. Consuming beta-carotene supplements is unlikely to have a substantial effect on the risk of non-melanoma skin cancer. Consuming calcium supplements probably protects against colorectal cancer (see Exposures: Other dietary exposures).

Justification

Randomised controlled trials of high-dose supplements have not been able to demonstrate protective effects of micronutrients on cancer risk suggested by observational epidemiology. Furthermore, some trials have shown potential for unexpected adverse effects.

The Panel is confident that for most people consumption of the right food and drink is more likely to protect against cancer than consumption of dietary supplements.

There is evidence from clinical trials that high-dose beta-carotene supplements may increase the risk of lung cancer in current and former smokers. However, these findings may not apply to the general population. Further details of evidence and judgements can be found in Exposures: Other dietary exposures.

Disparity between the beneficial effects of micronutrients from foods observed in long-term epidemiological dietary data and the lack of beneficial effects observed in short-term supplements trial data can lead to uncertainty as to the effect of dietary supplements on cancer risk [91].

The Panel recognises that in some situations, such as:
– in preparation for pregnancy
– in dietary inadequacy
supplements may be advisable to prevent nutrient or calorie deficiencies (see **Box 7**). In general, for otherwise healthy people, adequate intake of nutrients can be achieved by nutrient-dense diets.

This Recommendation is intended to be one in a comprehensive package of behaviours that, when taken together, promote a healthy dietary and lifestyle pattern conducive to the prevention of cancer and other NCDs.

Goal

GOAL **High-dose dietary supplements are not recommended for cancer prevention – aim to meet nutritional needs through diet alone**

This Recommendation applies to all doses and formulations of supplements, unless supplements have been advised by a qualified health professional who can assess potential risks and benefits.

Implications for other diseases

Supplementation may be needed to achieve adequate intake of nutrients in populations or people with nutrient insufficiency. For example, people with dietary anaemia may need iron and folic acid supplementation [92]. To promote bone health, adequate calcium intakes and adequate supply of vitamin D are required; supplementation is sometimes necessary [68] (see **Box 7** and **Appendix 1**).

In some parts of the world, populations may have endemic levels of micronutrient deficiencies that may increase the risk of NCDs, and in the absence of a secure varied food supply, supplements may have important health benefits.

Public health and policy implications

In many parts of the world, nutritional inadequacy is endemic [93]. In crisis situations it is necessary to supply supplements of nutrients to such populations or to fortify food to ensure at least minimum adequacy of nutritional status.

The best approach is to protect or improve local food systems so that they are nutritionally adequate and promote healthy diets. This also applies in high-income countries, where impoverished communities and families, and vulnerable people, including those living alone, the elderly, and the chronically ill or infirm, may also be consuming nutritionally inadequate diets. In such cases of immediate need, supplementation is necessary. See **Box 7**.

Policymakers should aim to maximise the proportion of the population achieving nutritional adequacy without dietary supplements by implementing policies that create a healthy food environment and food system. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Other dietary exposures

CUP cancer reports

CUP systematic literature reviews

Box 7: When supplements are advisable

In populations with secure food supplies and access to a variety of food and drink, dietary supplements are generally unnecessary for cancer prevention when people follow the Cancer Prevention Recommendations. Furthermore, in diets, nutrients are usually present with other bioactive substances and in combinations often not found in 'multi' supplements.

The Panel recognises, however, that dietary supplements, in addition to varied diets, may at times be beneficial for specific population groups. Examples include the following:

- vitamin B12 for people over the age of 50 who have difficulty absorbing naturally occurring vitamin B12
- iron and folic acid supplements for women who may become or are pregnant
- vitamin D supplements for infants and young children and for pregnant and breastfeeding women, although specific recommendations for iron and vitamin D supplementation vary between countries.

The Panel advises against the use of supplements as protection against specific cancers. The findings on calcium and reduced risk of colorectal cancer apply in specific settings and specific doses.

Advice for people who, due to deficiency, could benefit from supplementation, is best given in a clinical setting by an appropriately qualified health professional.

RECOMMENDATION

For mothers: breastfeed your baby, if you can

Breastfeeding is good for both mother and baby

GOAL **This recommendation aligns with the advice of the World Health Organization, which recommends infants are exclusively breastfed[1] for 6 months, and then up to 2 years of age or beyond alongside appropriate complementary foods**

[1] 'Exclusive breastfeeding' is defined as giving a baby only breastmilk (including breastmilk that has been expressed or is from a wet nurse) and nothing else – no other liquids or solid foods, not even water [98]. It does, however, allow the infant to receive oral rehydration solution, drops or syrups consisting of vitamins, minerals, supplements or medicines [98].

Summary of evidence from the Continuous Update Project

Overview

There is strong evidence that breastfeeding helps protect against breast cancer in the mother and promotes healthy growth in the infant.

More detail

Lactation probably protects the mother against breast cancer. Having been breastfed probably protects children against excess weight gain, overweight and obesity, and therefore those cancers for which weight gain, overweight and obesity are a cause (see Exposures: Lactation and Energy balance and body fatness).

Justification

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

Data from WHO show that the percentage of infants who are exclusively breastfed for the first 6 months of life is highest in low-income countries (47 per cent) and lowest in upper-middle-income countries (29 per cent) [94]. The global average prevalence is 36 per cent [95].

For mothers, lactation helps protect against breast cancer. Further details of evidence and judgements can be found in Exposures: Lactation.

For children, having been breastfed reduces the risk of overweight and obesity. Excess body fatness tends to track into adult life, and excess body fatness during childhood is associated with an earlier menarche in girls, which could increase the risk of several cancers (see Energy balance and body fatness). In addition, breastfeeding protects the development of the immature immune system and protects against infections in infancy and other childhood diseases [96]. Breastfeeding is vital in parts of the world where water supplies are not safe. Breastfeeding is also important for the development of the bond between mother and child.

The Recommendation is consistent with a large body of evidence [97] supporting the role of breastfeeding in promoting other aspects of health throughout the life course. At the beginning of life, human milk is best.

Goal

GOAL **This recommendation aligns with the advice of the World Health Organization, which recommends infants are exclusively breastfed for 6 months, and then up to 2 years of age or beyond alongside appropriate complementary foods.**

'Exclusive breastfeeding' is defined as giving a baby only breastmilk (including breastmilk that has been expressed or is from a wet nurse) and nothing else – no other liquids or solid foods, not even water [98]. It does, however, allow the infant to receive oral rehydration solution, drops or syrups consisting of vitamins, minerals, supplements or medicines) [98]. This forms part of the Global Nutrition Targets 2025 [99].

The benefits for both mother and baby are greater the longer the cumulative duration of breastfeeding.

There are special situations where breastfeeding is recommended with caution or is not advised, such as for mothers with HIV/AIDS; see WHO guidance for further information [100].

Implications for other diseases

Breastfeeding provides short- and long-term benefits for both mother and baby [96].

There is well-established evidence that the incidence of infections, as well as mortality rates, during infancy are lower in children who are breastfed [101].

Benefits of being breastfed continue into childhood and adulthood, with lower risks of other diseases, such as asthma [96]. Having been breastfed protects against obesity in childhood, and there is some evidence to suggest that the risk of type 2 diabetes is reduced in adulthood [96].

Mothers who breastfeed have a lower risk of type 2 diabetes [96] (see also **Appendix 1**).

Public health and policy implications

In most countries, only a minority of mothers exclusively breastfeed their babies until 4 months, and an even smaller number until 6 months [96].

A whole-of-government, whole-of-society approach is necessary to create environments for mothers that are conducive to breastfeeding their babies.

A comprehensive package of policies is needed to promote, protect and support breastfeeding, including making all hospitals supportive of breastfeeding, providing counselling in health care settings, implementing maternity protection in the workplace, and regulating marketing of breastmilk substitutes. Policymakers are encouraged to frame specific goals and actions according to their national context.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Exposures: Lactation

Energy balance and body fatness

CUP cancer reports

CUP systematic literature reviews

RECOMMENDATION

After a cancer diagnosis: follow our Recommendations, if you can

Check with your health professional what is right for you

GOAL All cancer survivors[1] should receive nutritional care and guidance on physical activity from trained professionals

GOAL Unless otherwise advised, and if you can, all cancer survivors are advised to follow the Cancer Prevention Recommendations as far as possible after the acute stage of treatment

[1] Cancer survivors are people who have been diagnosed with cancer, including those who have recovered from the disease.

Summary of evidence from the Continuous Update Project

Overview

The available evidence on the effect of diet, nutrition and physical activity on the risk of cancer in cancer survivors is limited. The amount and quality of research in this area is insufficient to make firm conclusions.

More detail

Cancer survivors are people who have been diagnosed with cancer, including those who have recovered from the disease.

Research on the effects of diet, nutrition and physical activity on the risk of cancer in cancer survivors is growing. However, to date the Panel has reviewed the evidence for the effects of these lifestyle factors only on survival and future risk of breast cancer.

There is a lack of evidence from randomised controlled trials. In addition, the quality of most published observational studies has been limited because they did not adequately account for factors such as cancer subtypes, type and intensity of treatment, and other illnesses. These limitations are also likely to apply to studies on survivors of other cancers (see Survivors of breast and other cancers).

Breast cancer survivors. The evidence is persuasive that nutritional factors (in particular body fatness) and physical activity reliably predict important outcomes from breast cancer. However, the evidence that changing these factors would alter the clinical course of breast cancer is limited, particularly by the quality of published studies.

Diet, nutrition and physical activity before breast cancer diagnosis: There is limited evidence that being physically active and consuming a diet higher in foods containing dietary fibre before a diagnosis of breast cancer reduces the chances of dying earlier after diagnosis. There is limited evidence that greater body fatness or consuming a diet higher in fat or saturated fatty acids before a diagnosis of breast cancer increases the risk of dying earlier after diagnosis.

Diet, nutrition and physical activity after breast cancer diagnosis[1]: There is limited evidence that being physically active or eating a diet higher in foods containing dietary fibre or soy after a diagnosis of breast cancer decreases the risk of dying earlier after diagnosis. There is limited evidence that greater body fatness after diagnosis of breast cancer increases the risk of dying earlier after a diagnosis.

Justification

Subject to the qualifications made here, the Panel agrees that the conclusions underpinning the Cancer Prevention Recommendations are also likely to be relevant to cancer survivors. The Panel recommends that, as far as possible, cancer survivors should aim to follow these Recommendations once treatment has finished. There may be specific situations where this advice may not apply and guidance from health professionals may be needed.

The Panel has made this judgement based on its examination of the evidence, including that specifically on breast cancer survivors, and on its collective knowledge of the biology of cancer and its interactions with diet, nutrition, physical activity and body fatness.

Although there are strong associations between some lifestyle exposures and various breast cancer outcomes, the evidence is not strong enough to conclude that these are causal. The evidence is insufficient to make firm recommendations on exposures that reduce the risk of all-cause mortality and morbidities that apply to cancer survivors as a whole or to those who are survivors of any specific cancer. Nevertheless, the Recommendation is based on the best evidence available. However, following the Recommendations is likely to reduce the risks of other NCDs, which are an important cause of morbidity and mortality in cancer survivors. This is increasingly important as improvements in cancer treatment extend survival. Further details of evidence and judgements can be found in Survivors of breast and other cancers and CUP breast cancer survivors report 2014.

Treatment of cancer is increasingly personalised and integrates multiple approaches such as surgery, radiation and chemotherapy. It is likely that future recommendations will be more specific, based on the effectiveness of treatment and the occurrence of side effects in well-conducted clinical trials.

Goals

GOAL **All cancer survivors should receive nutritional care and guidance on physical activity from trained professionals**

The circumstances of cancer survivors vary greatly. There is increased recognition of the potential importance of diet, nutrition, physical activity and body fatness in cancer survival. People who have been diagnosed with cancer should be given the opportunity, as soon as possible, to consult an appropriately trained health professional, who can take into account each person's circumstances.

People who are undergoing treatment for cancer are likely to have special nutritional requirements, as are people after treatment whose ability to consume or metabolise food

[1] After breast cancer diagnosis refers to 12 months or more after diagnosis.

has been altered by treatment and people in the later stages of cancer whose immediate need is to arrest or slow down weight loss. These are all clinical situations where the advice of an appropriately trained health professional is essential.

Unless specifically advised by an appropriately trained professional, the evidence does not support the use of supplements as a means of improving survival.

Goals

GOAL **Unless otherwise advised, and if you can, all cancer survivors are advised to follow the Cancer Prevention Recommendations as far as possible after the acute stage of treatment**

There is growing evidence that physical activity and other measures that control weight may help to improve survival and health-related quality of life after a breast cancer diagnosis. These findings are in line with the Cancer Prevention Recommendations. Cancer survivors are also likely to gain health benefits related to other conditions, as well as a sense of control, from regular physical activity at levels that they can sustain.

Implications for other diseases

Following the Cancer Prevention Recommendations is likely to help prevent other NCDs [29–31] as well as to help management and control of co-existing NCDs which can complicate treatment and reduce survival (see **Appendix 1**).

Public health and policy implications

More people are surviving cancer than ever before, at least in part because of earlier detection and the increasing success of treatment for many cancers. As a result, cancer survivors are living long enough to develop new primary cancers or other NCDs. Following the Cancer Prevention Recommendations may improve survival and reduce the risks of cancer and of other NCDs, and so can be recommended on that basis.

A comprehensive whole-of-government, whole-of-society approach is necessary to create environments for cancer survivors that are conducive to following the Cancer Prevention Recommendations, and future, more specific evidence-based recommendations for cancer survivors.

For more information about the public health and policy implications of the Cancer Prevention Recommendations, see **Section 4**.

For further information on the evidence, analyses and judgements that led to this Recommendation, see the following parts of the Third Expert Report available online:

Survivors of breast and other cancers

CUP breast cancer survivors report 2014

Energy balance and body fatness

CUP cancer reports

CUP systematic literature reviews

3. Regional and special circumstances

The Recommendations and Goals in **Section 2** are generally relevant worldwide. This section summarises findings of the Continuous Update Project that were not suitable for inclusion in the global Recommendations even though the Panel judged the evidence to be strong (either 'probable' or 'convincing'). There are four main reasons why this evidence does not feature in the global Recommendations:

- The exposure is a public health issue that people cannot necessarily influence themselves:
  - Height and birthweight
  - Arsenic in drinking water
  - Aflatoxins
- The exposure is only relevant in specific parts of the world:
  - Mate
  - Foods preserved by salting
  - Cantonese-style salted fish
- There is inadequate information about certain factors:
  - Coffee
  - 'Mediterranean type' dietary pattern
- The evidence is divergent between cancer sites:
  - Dairy products and calcium

Where appropriate, this section includes locally applicable actions and highlights further research needed.

Issues of public health significance

The following exposures are judged to be causally linked to cancer risk but are not necessarily within the capacity of any individual to alter, and therefore inappropriate to include in the global Recommendations. In some cases, actions have been recommended for authorities with responsibilities for public health and for individuals.

Height and birthweight

The Panel's judgements:

- **There is convincing evidence that developmental factors leading to greater growth in length in childhood (marked by adult attained height) are a cause of cancers of the colorectum, ovary and breast (both pre- and postmenopause)**
- **Developmental factors leading to greater growth in length in childhood (marked by adult attained height) are probably a cause of cancers of the pancreas, kidney, endometrium, prostate and skin (malignant melanoma)**
- **Factors that lead to greater birthweight, or its consequences, are probably a cause of premenopausal breast cancer.**

The Panel considers height and birthweight to be markers of genetic, environmental, hormonal and nutritional factors that affect growth during the period from preconception to completion of linear growth, and that these factors affect the risk of cancer. Further details of evidence and judgements can be found in Exposures: Height and birthweight.

Growth in childhood is a predictor of age at sexual maturity and eventual adult attained height. Rate of growth both depends on and can in its turn influence metabolic and hormonal factors. These metabolic and hormonal factors can trigger lifelong consequences although the precise mechanisms by which they operate are currently unclear [102].

The association between height and birthweight, and cancer, is different to the association between these factors and some other NCDs, such as CVD. Thus, a greater birthweight and being taller in adulthood predict a lower risk of CVDs [103] in contrast to the higher risk of many cancers (see Exposures: Height and birthweight).

To date, growth standards have not taken into account the lifelong risk of NCDs, including cancer, as policies and programmes have focused on the need to provide adequate nutrition to prevent retarded growth [104]. This remains an issue for some parts of the world.

Although birthweight and adult attained height are linked to cancer risk, in adulthood there is no way to modify these factors so a better understanding of the developmental factors that underpin the association between greater growth and cancer risk is needed.

For all these reasons height and birthweight are not subject to a Recommendation.

Arsenic in drinking water

The Panel's judgements:

- **There is convincing evidence that consumption of arsenic in drinking water is a cause of lung cancer**
- **Consumption of arsenic in drinking water is probably a cause of bladder and skin cancer.**

Water supplies may become contaminated with arsenic as a result of agricultural, mining and industrial practices, although arsenic can also occur naturally in water due to volcanic activity. Inorganic arsenic (arsenate or arsenite) is the form that predominantly contaminates drinking water.

The primary regions where high concentrations of arsenic have been measured in drinking water include large areas of Bangladesh, China and West Bengal (India), and smaller areas of Argentina, Australia, Chile, Mexico, Taiwan (China), the USA, and Vietnam [9]. In many of these regions, the drinking water comes from groundwater naturally contaminated by arsenic-rich geological formations [9]. In some areas of Japan, Mexico, Thailand, Brazil, Australia, and the USA, mining, smelting and other industrial activities have contributed to elevated concentrations of arsenic in local water sources [9].

IARC has judged arsenic and inorganic arsenic compounds to be carcinogenic to humans [9]. Drinking water contaminated with arsenic is also classed separately as a human carcinogen [9].

Arsenic is genotoxic in humans and experimental studies suggest that exposure to arsenic and its metabolites induces excessive reactive oxygen species, thereby inducing DNA damage, altering transcription factor function and modulating the expression of genes involved in cell growth, survival and cancer risk [105, 106].

The joint Food and Agriculture Organization of the United Nations/WHO Expert Committee on Food Additives has set a provisional tolerable weekly intake of 0.015 milligrams of arsenic per kilogram of body weight [107]. Further details of evidence and judgements can be found in Exposures: Non-alcoholic drinks.

Actions:

- **Do not use any source of water that may be contaminated with arsenic.**
- **Authorities should ensure that safe water supplies are available when such contamination occurs.**

Aflatoxins

Microbial contamination of foods remains a major public health problem [108]. Some foods may become contaminated with aflatoxins, which are produced by some moulds when the foods are stored for too long at warm temperatures in a humid environment. Foods that may be affected by aflatoxins include cereals, spices, peanuts, pistachios, Brazil nuts, chillies, black pepper, dried fruit and figs.

The Panel's judgement:

- **There is convincing evidence that higher consumption of aflatoxin-contaminated foods is a cause of liver cancer.**

The prudent approach is to avoid consumption of any cereals (grains) or pulses (legumes) that may have been stored for a relatively long time in warm, ambient temperatures, with high humidity, even if they show no visible signs of mould. Some grains are susceptible to moulds that may produce other mycotoxins. Further details of evidence and judgements can be found in Exposures: Wholegrains, vegetables and fruit.

Actions:

- **Do not eat mouldy cereals (grains) or pulses (legumes).**
- **Governments should ensure that facilities for the safe storage of foods are made available in areas at risk of aflatoxin contamination.**

Issues relevant only in specific parts of the world

Some evidence on the consumption of certain food and drink is specific to particular regions of the world. If these foods or drinks were consumed elsewhere, they might have the same effects. However, people in the rest of the world currently do not consume them.

These foods and drinks include mate, salt-preserved foods and Cantonese-style fish.

The Panel considers that detailed recommendations in these cases are most appropriately made by local and/or regional regulatory authorities, other policymakers and health professionals in the relevant countries. It has recommended general actions for the relevant authorities and for people.

Mate

The Panel's judgement:

- **Consumption of mate, as drunk in the traditional style in South America, is probably a cause of oesophageal squamous cell carcinoma.**

Mate, an aqueous infusion prepared from dried leaves of *Ilex paraguariensis*, is traditionally consumed scalding hot following repeated addition of almost boiling water to the infusion. Mate is consumed mainly in South America, specifically in Argentina, Bolivia, Brazil, Chile, Ecuador, Paraguay and Uruguay.

Any carcinogenic effects of mate are believed to be due to its consumption at very hot temperatures (over 70°C), which can cause chronic mucosal injury that can promote tumorigenesis in the mouth, pharynx, larynx and oesophagus [109, 110].

Further details of evidence and judgements can be found in Exposures: Non-alcoholic drinks.

Action:

- **The Panel recognises that consumption of mate is a traditional practice in parts of South America. However, for cancer prevention, do not consume mate as drunk scalding hot in the traditional style.**

Foods preserved by salting

The evidence on foods preserved by salting that was considered in the CUP included data from studies on salt-preserved vegetables, salt-preserved fish and salt-preserved foods. The majority of studies were conducted in Asia.

The Panel's judgement:

- **Consumption of foods preserved by salting (including salt-preserved vegetables, fish and foods in general) is probably a cause of stomach cancer.**

Animal models have shown that high salt levels alter the mucus viscosity protecting the stomach and enhance the formation of *N*-nitroso compounds [111]. In addition, high salt intake may stimulate the colonization of *Helicobactor pylori*, the strongest known risk factor for stomach cancer [112]. Finally, in animal models, high salt levels have been shown to be responsible for the primary cellular damage which results in the promotion of stomach cancer development [113].

Preserved foods may be eaten more by people who do not have access to refrigeration. The use of pickled vegetables may therefore be associated with poor socio-economic status, and thus with a high prevalence of *Helicobacter pylori* infection, leading to the possibility of association by confounding factors [114].

Further details of evidence and judgements can be found in Exposures: Preservation and processing of foods.

Actions:

- **Do not consume salt-preserved, salted, or salty foods.**
- **Preserve foods without using salt.**

Cantonese-style salted fish

Cantonese-style salted fish is part of the traditional diet consumed by people living in the Pearl River Delta region in Southern China. It has even been given to children, as part of a weaning diet [115]. This style of fish, which is prepared with less salt than is used on the northern Chinese littoral, is allowed to ferment, and so is eaten in a decomposed state.

The Panel's judgement:

- **Consumption of Cantonese-style salted fish is probably a cause of nasopharyngeal cancer.**

There is no evidence that other forms of preserved fish affect the risk of cancer. Further details of evidence and judgements can be found in Exposures: Meat, fish and dairy products.

Actions:

- **Do not consume Cantonese-style salted fish.**
- **Do not feed fish prepared in this way to children.**

Issues of inadequate information

For some exposures, although the Panel judged there to be strong evidence of an effect on cancer risk and the association was judged causal, some aspects of that evidence, such as the influence of dose, were inadequate to permit a meaningful recommendation.

Coffee

Coffee is one of the main hot drinks consumed worldwide. It contains stimulants and other bioactive constituents.

The Panel's judgement:

- **Consumption of coffee probably protects against liver cancer and endometrial cancer.**

For liver cancer, no threshold was identified, and no evidence was found regarding specific components of coffee that might be responsible for the decreased risk. For endometrial cancer, the effect was observed for both caffeinated and decaffeinated coffee and could not be attributed to caffeine.

Across the globe, coffee is consumed in different ways. Before a general recommendation on cancer prevention can be made, more research is needed to improve understanding of how the volume and regularity of consumption, type of coffee, and style of preparation and serving (many people add milk and sugar) affect the risk of cancer. Further details of evidence and judgements can be found in Exposures: Non-alcoholic drinks.

'Mediterranean type' dietary pattern

Many studies have included a measure of adherence to the so-called 'Mediterranean type' dietary pattern. However, although there are recognised scores for quantifying adherence to such a diet [116–118], it is unclear exactly what such a diet comprises. It generally describes a diet rich in fruit, vegetables and unrefined olive oil, with modest amounts of meat and dairy, and some fish and wine.

This diet is traditionally associated with high levels of physical activity. Such a diet is one of many ways of life that could be followed to meet the Recommendations.

Currently the populations of most countries around the Mediterranean do not consume such a diet.

The Panel considered this type of diet as one example of an approach to meeting the Recommendations. Further details of evidence and judgements can be found in Energy balance and body fatness.

Issues on which the evidence is divergent between cancer sites

For some exposures, where the Panel judged there to be strong evidence of an effect on risk of one or more cancers, there was evidence of an opposite effect on another cancer or other disease. In these circumstances, a general recommendation is inappropriate.

Dairy products and calcium

The evidence on dairy products and diets high in calcium is mixed.

The Panel's judgements:

- **Consumption of dairy products probably protects against colorectal cancer**
- **Consumption of calcium supplements probably protects against colorectal cancer.**

There is strong evidence of a decreased risk for colorectal cancer. There is also limited but suggestive evidence that consumption of dairy products might increase the risk of prostate cancer.

Even though the strength of the evidence for prostate cancer fell below the general threshold required for making a recommendation, the possibility of an adverse effect is sufficient to warrant caution. The evidence of potential for harm means the Panel chose to make no recommendation on dairy products.

Further details of evidence and judgements can be found in Exposures: Meat, fish and dairy products.

4. Public health and policy implications

Background and need for action

The expected rise in the global cancer burden and the significant economic costs associated with cancer can take a heavy toll on those affected. With up to half of all cancer cases being preventable, it is crucial that governments prioritise the prevention of cancer. The same preventive strategies that target upstream determinants of cancer risk can often provide benefits across other NCDs, owing to common underlying risk factors, making a strong case for a coordinated policy approach.

The updated Cancer Prevention Recommendations featured in **Section 2** together constitute a blueprint for reducing cancer risk through changing dietary patterns, reducing alcohol consumption, increasing physical activity and achieving and maintaining a healthy body weight.[1] Together these factors represent the major modifiable risk factors for cancer after smoking (and other forms of tobacco use) [119]; for non-smokers, they are the most important means of helping prevent cancer [7].

The Recommendations provide guidance for people on how to reduce their risk by modifying their choices, and from a policy perspective can be divided into four main areas: diet, physical activity, alcohol consumption and breastfeeding, recognising that all of these factors also influence body weight.

However, although well-informed choices are important in influencing personal risks of cancer and other diseases, many factors, such as the availability of different foods and the accessibility of physical environments for active ways of life, are outside people's direct personal control. In order to effect change at a population level it is therefore critical to consider the environment within which people make their choices [18].

Environmental, economic and social factors are all important upstream determinants of the behaviours and choices that influence the risk of cancer (and of other NCDs). (For example, these factors result in food systems that mean the food that is available to people is more processed and often high in sugars, refined starches and fat, and environments that contribute to more sedentary lifestyles and thus increase overweight and obesity.)

Environmental, economic and social factors can also lead to health inequalities, as lower socio-economic groups are more likely to be affected by upstream determinants of cancer risk. Conversely, changing these upstream structural factors can reduce such inequalities.

The World Health Organization's (WHO) Global Action Plan for the Prevention and Control of Non-Communicable Diseases 2013–2020 [120] was created to strengthen national efforts to address the burden of NCDs. It includes a menu of policy options (updated in 2017 [121]) and nine voluntary global targets, including a 25 per cent relative reduction in premature mortality from NCDs by 2025.

Progress to date towards WHO targets has been insufficient, and more action is needed. Using a set of 18 indicators to track each country's progress on implementing NCD commitments, WHO found that of 194 countries, only 2 scored 14 fully achieved progress indicators, 14 countries were not achieving a single progress indicator and 20 were achieving only one of the indicators [122].

Sustainability is also important when

[1] The Panel emphasises the importance of not smoking, avoiding other exposure to tobacco, avoiding excess exposure of the skin to ultraviolet radiation (for example, sunlight) and preventing long-term infections that can cause cancer.

considering lifestyle factors that influence the risk of cancer and other NCDs (see **Box 8**). Supporting people and communities to follow the Cancer Prevention Recommendations contributes to the global sustainable development agenda by promoting dietary patterns based on foods of plant origin and helping to reduce premature mortality from cancer and other NCDs. With the world's population projected to reach 8.6 billion by 2030 and 9.8 billion in 2050, finding a way to feed the world sustainably is critical [123].

NCDs pose a major challenge to sustainable development, and as such they are integrated throughout the United Nations' 2030 Agenda for Sustainable Development [19]. Of particular relevance are two targets:

- Sustainable Development Goal (SDG) 3, target 3.4: 'by 2030, reduce by one-third premature mortality from NCDs through prevention and treatment and promote mental health and well-being'
- SDG 2, target 2.2: 'by 2030, end all forms of malnutrition'.

However, all the goals are important for addressing the social determinants of health.

Vulnerable populations are often hit hardest by the burden of NCDs and the impact of climate change; therefore policy responses that promote equity are needed.

Box 8: Sustainability and health

How we produce and consume food is possibly the most important determinant of both human and environmental health worldwide. The double burden of malnutrition (the coexistence of undernutrition with overweight, obesity or diet-related NCDs) affects billions of people globally and is occurring alongside major environmental challenges [124, 125].

Food production is directly or indirectly responsible for between 19 and 29 per cent of all greenhouse gas emissions, uses 70 per cent of available freshwater and is a major source of environmental pollution [126, 127]. Food production both contributes to climate change and is affected by it. Meat production in particular contributes significantly to greenhouse gas emissions, and red and processed meat consumption is strongly linked to colorectal cancer (see the Recommendation, 'limit consumption of red and processed meat') [128, 129].

Although current food systems have improved food security in many parts of the world, they are not serving human health well or operating in an environmentally sustainable way, with economic considerations often taking precedence. Dietary patterns that rely more on foods of plant than animal origin support the sustainable development agenda and offer benefits for both human and ecological environmental health [21].

Motor vehicle emissions contribute nearly a quarter of all greenhouse gas emissions and cause air pollution, particularly in urban areas. Transport policies and systems that prioritise walking, cycling and public transport provide opportunities for co-benefits: reducing fossil fuel consumption and traffic congestion, improving air quality and increasing the health benefits associated with being physically active [130].

Factors that affect the risk of cancer

The economic, social and environmental factors that determine patterns of production and consumption of food and drink, and levels of physical activity (and thus body composition), overlap and operate on global, national and local levels. These factors are experienced at a personal level through their effects on the availability, affordability, awareness and acceptability of healthy foods, drinks and lifestyles – as well as breastfeeding[1] – relative to unhealthy food and drink, alcohol and physical inactivity [131] (see **Box 9**).

Understanding the determinants of cancer risk highlights opportunities for policy action. Protecting public health, including creating health-enabling environments, is the prime responsibility of government as decision makers and caretakers. Achieving healthy patterns of diet and sustained physical activity over the life course (see **Box 10**) requires concerted and integrated action from all sectors of society, including those in civil society, the private sector, and health and other professions.

Box 9: The nutrition transition

The nutrition transition is a shift in the patterns of food consumption and physical activity (and so of energy expenditure) that coincides with economic, demographic and epidemiological changes. It has occurred, or is occurring, in many countries. More specifically, the term is used for the transition of low- and middle-income countries from traditional ways of life and plant-based diets high in relatively unprocessed foods to more Western diets with more processed foods high in sugars and fat, more food from animal sources, less physical activity and more sedentary time.

The nutrition transition reflects profound physical, economic and social changes in the environment in which people make choices about diet and activity [12, 132]. It leads to tangible changes in a population's health, including an increased prevalence of overweight and obesity, and the conditions associated with them.

Box 10: The life course

A 'life course' approach takes into account the whole period of life, from conception (and preconception) to death (and on to the next generations). It pays special attention to times in life when particular actions may have lasting effects, and so when protection of health and prevention of disease is particularly important [102].

The provision of nutrients in the womb, and what we eat and how active we are from birth onwards influences the size, shape and maturation of the human body throughout life. For undernutrition, overweight, obesity and diet-related NCDs, the very earliest period of life, from pre-conception to the age of 2 years (the first 1,000 days), is particularly important [133].

It is important to develop and implement policies that have an impact at key time periods across the life course to improve overall health and help reduce overweight, obesity and diet-related NCDs.

[1] Policies are needed to promote, protect and support breastfeeding; however, it is recognised that not all mothers are able to breastfeed.

Using a policy framework to support action

Policy frameworks

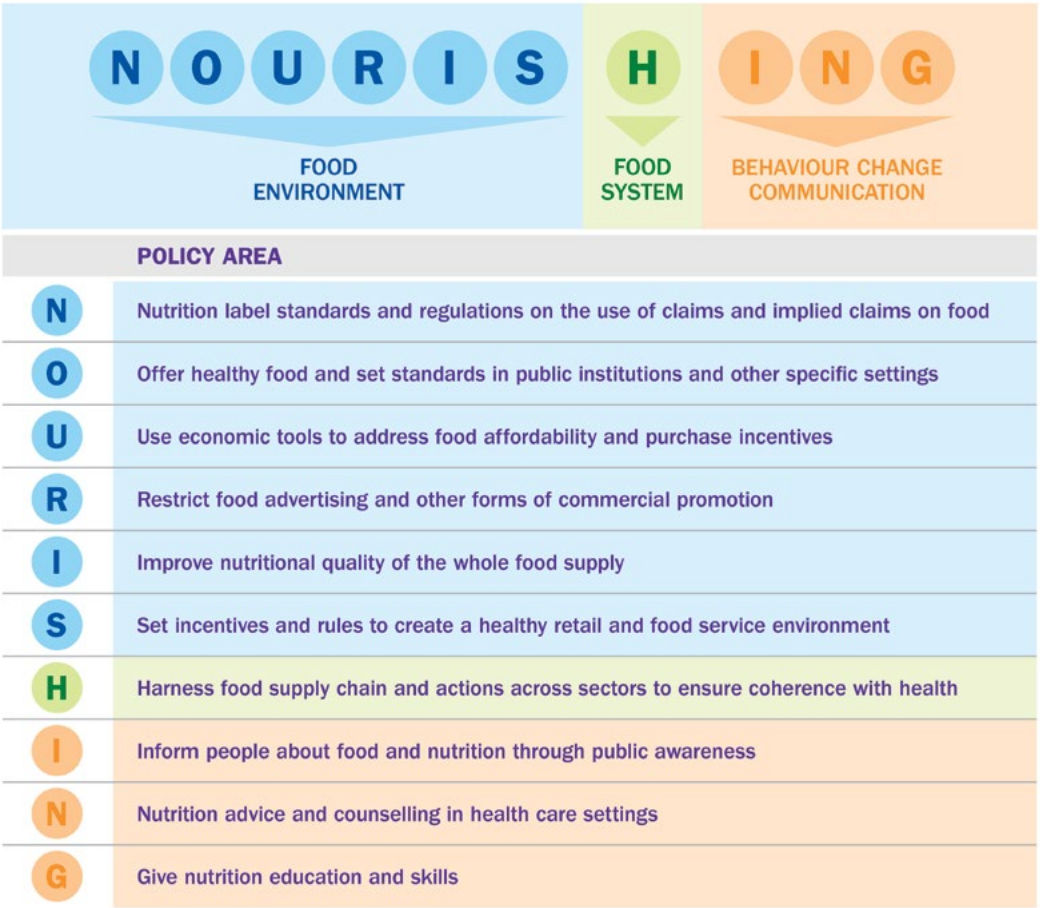
A whole-of-government, whole-of-society approach is needed to create environments for people and communities that are conducive to following the Cancer Prevention Recommendations (and improving overall health outcomes).

In order to develop an appropriate and coordinated response, a framework-type approach, as illustrated by the NOURISHING framework described below, is useful. Policy frameworks can help policymakers to:

- conceptualise, organise and package policies to address risk factors
- plan, develop, implement and evaluate policies
- identify available policy levers and policy options that can be used to create health-enhancing environments
- develop a comprehensive policy approach that can be adapted to reflect national contexts.

When implemented, such policy frameworks have the potential to achieve system-wide change. Because cancer and other NCDs share some common risk factors, policies that target those risk factors have the potential for a significant positive impact on health.

Figure 1: The NOURISHING framework



The WCRF International NOURISHING framework formalises a comprehensive package of policies to promote healthy diets and reduce overweight, obesity and diet-related non-communicable diseases.

Box 11: The NOURISHING policy database

Accompanying the framework is the NOURISHING database, which provides an extensive, regularly updated compendium of policy actions implemented in countries around the world. A structured methodology is followed when compiling and updating the database [135], which includes a process to verify the details and implementation of all policy actions included with in-country or regional policy experts, wcrf.org/NOURISHING

Box 12: Uses of NOURISHING for different target audiences

Policymakers:

- Enable and inform policy development and strategic direction
- Identify where action is needed to promote healthy diets, and reduce obesity and other NCDs, including cancer
- Select and tailor policy options suitable for different populations
- Assess whether an approach is comprehensive

Civil society organisations:

- Monitor what governments are doing
- Benchmark progress
- Hold governments to account
- Assist governments in developing appropriate responses

Researchers:

- Identify the evidence available for different policies
- Identify research gaps
- Monitor and evaluate policies

The NOURISHING framework

A well-developed example of a framework-type approach is WCRF International's NOURISHING food policy framework (see **Figure 1**). Developed in 2013, the framework formalises a comprehensive package of policies to promote healthy diets and reduce overweight, obesity and diet-related NCDs, including cancer [134]. It builds on the conceptual framework developed for the 2009 Policy Report [32], outlining policy areas to address factors that influence the availability, affordability, awareness and acceptability of healthy diets.

The NOURISHING framework, together with its accompanying database of implemented policies from around the world (see **Box 11**), is a tool designed to help policymakers, civil society organisations and researchers (see **Box 12**).

The NOURISHING framework outlines 10 areas in which governments need to take action, across three domains: ***food environment***, ***food system*** and ***behaviour change communication*** (see **Figure 1**). Each letter in NOURISHING represents a different policy area; for example, 'N' is for 'Nutrition label standards and regulations on the use of claims and implied claims on foods', 'O' is for 'Offer healthy foods and set standards in public institutions and other settings', and so on.

A comprehensive approach to policy – taking action across all 10 policy areas outlined in the framework – is vital to make progress in promoting healthy diets and reducing overweight, obesity and diet-related NCDs, including cancer.

Example policy options across the different policy areas include the following:

- nutrition labelling on the front of the pack on food products
- mandatory nutrition standards for food offered and sold in schools
- taxes on sugary drinks
- mandatory restrictions on all forms of marketing of unhealthy food and drink to children
- mandatory limits on salt and mandatory removal of trans fats in food products
- initiatives to increase the availability of healthier foods in stores and food service outlets
- nutrition standards for public procurement
- food-based dietary guidelines and public awareness campaigns on healthy eating
- nutrition counselling in primary care
- nutrition and cooking skills on school curricula.

Broader application of the NOURISHING framework

The NOURISHING framework covers a subset of the Cancer Prevention Recommendations. Its purpose is to focus on promoting healthy diets. It does not include policy areas related to physical activity, alcohol consumption or breastfeeding.

Various other policy frameworks, strategies and plans [18, 136–144] outline approaches to address these factors in a comprehensive way, including potential policy options. However, these approaches do not always offer an easily accessible overview of the key policy areas where action is needed. One of NOURISHING's strengths is the way it categorises the numerous policy options to promote healthy diets into 10 overarching policy areas across the three domains of food environment, food system and behaviour change communication.

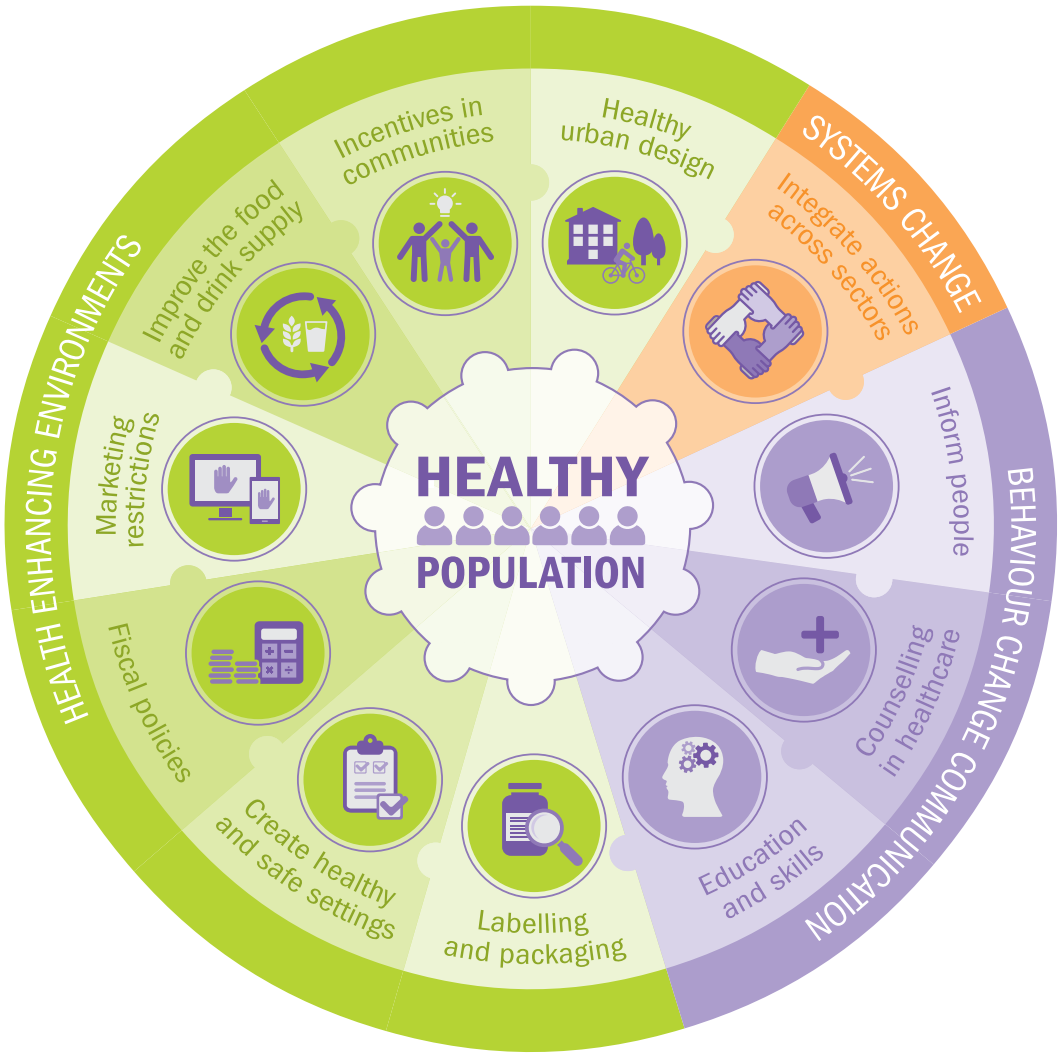
Given the success of the NOURISHING framework in enabling policymakers, researchers and civil society organisations to advocate for and implement government policies to promote healthy diets,[1] WCRF International has used it to inform the development of a new structured policy framework that also addresses physical activity, alcohol consumption and breastfeeding. Common policy levers – broadly policy measures that influence availability, affordability, awareness and acceptability – can be used to promote healthy diets, physical activity and breastfeeding, and reduce alcohol consumption.

To address diet, physical activity, alcohol consumption and breastfeeding, the new WCRF International policy framework has broadened NOURISHING's three overarching policy domains to ***health-enhancing environments, systems change*** and ***behaviour change communication*** and modified and expanded NOURISHING's 10 policy areas to 11, to include healthy urban design (see **Figure 2**).

Using the adapted framework, **Appendix 2** categorises selected policy options for policy options for diet, physical activity, alcohol consumption and breastfeeding across the 11 broad policy areas and three domains. The policy options featured in **Appendix 2** are drawn from existing strategies, frameworks and plans. They help frame the policies that are needed to create environments for people and communities that are conducive to leading healthier lives and following all of the Cancer Prevention Recommendations.

[1] As evidenced by the wide uptake of NOURISHING by policymakers, researchers and civil society organisations.

Figure 2: A new policy framework to address diet, physical activity, breastfeeding and alcohol consumption



A new policy framework that can be used to identify a comprehensive package of actions needed to create environments for people and communities that are conducive to following the Cancer Prevention Recommendations.

A comprehensive approach to policy

Responsibility for health

Securing public health requires the organised efforts of society as a whole. There are many ways of characterising how society is constructed. One example features four main pillars – multinational and regional bodies, government, private sector and civil society. Each pillar can be segmented into different groups of policymakers and decision makers. These include, but are not limited to, systems of government, civil society organisations, national and international professional and other bodies, private sector entities, professionals and other workers, philanthropic and other funding organisations, academia and people themselves as members of communities and families, and as individuals.

These actors work across different settings, including schools and other educational institutions, workplaces, public institutions, cities, towns and rural communities, media, social media and networks, and homes.

The common feature of successful policy is concerted action led by governments (and

Figure 3: Impact of concerted action

The common feature of successful policy is concerted action led by governments with the support of actors across all sectors in society, all working in the public interest.

through them multinational and regional bodies), with the support of civil society and professional organisations, all working in the public interest (see **Figure 3**). However, the development, adoption and implementation of policies to promote public health are often strongly opposed by industry and other actors (for example, government agencies concerned with trade), who may see such policies as obstructing their interests. Strategic advocacy efforts by civil society and professional organisations working in the public interest can help counter this opposition.

All actors have an opportunity, and in many cases a responsibility, to make decisions with a view to their impact on public health, including cancer prevention. This is very difficult to achieve unless joint and coordinated action is mandated from and supported by the highest level of government.

The impact of policies and actions depends on successful, mutually reinforcing, interactions among all actor groups. This is challenging due to the perceived or potential negative impacts of particular policies on some actors' core goals. Policies targeted at a single outcome or a narrow range of outcomes, even if successful in their own right, rarely achieve lasting health benefit on their own, because health outcomes are the result of a multitude of interdependent elements within a connected system that interact and affect each other in a variety of ways [145]. All policies depend to some extent on action being taken across actor groups, as the benefit from two or more actors working synergistically is greater than the sum of the benefits from working separately.

The importance of policy coherence

When considering the prevention of cancer and other NCDs, it is important to strive for policy coherence – when policies work together to achieve objectives that have been agreed by government, rather than undermining each other. Multiple, mutually enforcing, coherent actions are needed across government to support people and communities to adopt healthy behaviours and to leverage support from other sectors by identifying co-benefits.

It can be especially challenging to achieve coherence between trade and economic policies on the one hand (which provide, for example, legal frameworks enabling and promoting trade) and health and nutrition policies on the other (which aim to build a healthier food environment and enable a population to be as healthy as possible). For example, policy actions put in place to reduce the consumption of high-calorie foods may conflict with trade policies that make it easier to obtain ingredients used in the manufacture of these products [134].

Governance structures that support engagement of multiple sectors and stakeholders can help improve policy coherence. Such structures need political support from the highest level and should involve all relevant ministries, and, to varying degrees, civil society organisations and the private sector (as appropriate), with robust safeguards in place against conflicts of interest (see **Box 13**).

Monitoring and evaluation of impact and effectiveness

It is critically important to develop a framework for monitoring and evaluating policies, to assess the impact and effectiveness of implemented policies, prior to the implementation of regulatory measures. Such monitoring and evaluation needs to be an integral part of any policy process. This requires dedicated funding and appropriately trained staff.

Box 13: Protecting policymaking from conflicts of interest

It is important to consider how the core interests of different actors might conflict with those of health, and whether the way they conduct their activities helps or hinders the promotion of healthy diets, physical activity and breastfeeding, and the reduction of alcohol consumption.

Governments bear responsibility for setting the policy and regulatory framework for promoting health, and for the prevention of cancer and other NCDs.

Bodies such as the World Health Organization (WHO) also have responsibility for establishing normative standards in public health. The need to protect the WHO against conflict of interest from industries whose policies or activities negatively affect human health, including cancer and other NCDs, and are not in line with WHO policies, norms and standards – which may include the food and beverage industry – is acknowledged in paragraph 45 of the WHO Framework of Engagement with Non-State Actors (FENSA) [146].

Industry does have a role to play, but this role should be restricted to the implementation stage of the policymaking process. It is not the role of industry, in particular the food and beverage industry, to be involved in setting policies (aside from when called upon to give specific feedback), owing to the inherent and unavoidable conflict of interest.

Key questions to consider when engaging with private sector entities include the following:

- **Are the actor's core products and services damaging to health?**
- **Are corporate social responsibility practices independently audited?**
- **Does the actor make positive contributions to health beyond its corporate social responsibility practices?**
- **How are partnerships defined?**
- **Are there clear parameters for engagement between actors, including explicit commencement and termination dates and responsibilities?**

Monitoring is an ongoing process that uses the systematic collection of data on specified indicators to assess the extent of progress towards the achievement of a policy's objective. A good monitoring system provides information about whether a policy's implementation is on course and whether it is performing as expected. Monitoring compliance, and imposing effective sanctions for violations, is critical to enforce regulations.

In contrast, evaluation is the systematic assessment of a policy's design, implementation and outcomes, used to draw conclusions about a policy's relevance, effectiveness, cost-effectiveness, efficiency, impact and sustainability. It provides a basis for revising and improving policy over time. A key issue to track is whether policies are capturing high-risk subgroups and whether policies are narrowing or widening the gaps that they are meant to address.

'Real world' implementation of policies can have unintended positive, negative or neutral impacts. As such, it is necessary to monitor and evaluate policies to determine whether they are having the anticipated impact(s) along the pathway of effects and, if not, why, so the policy can be adjusted accordingly. Reliable indicators and appropriate research designs are needed to ensure relevant outcomes are measured, and so it is possible to attribute changes in indicators to the policy being evaluated [147].

Evaluating policies is also valuable beyond the geographic and social contexts in which they are implemented. For example, other countries can benefit from lessons learned when developing and implementing a policy, including factors that promoted or obstructed success. Too few evaluations of implemented policies are being conducted, with most evaluations taking place in high-income countries.

Efforts exist to monitor government action in promoting healthy diets. INFORMAS [148] (International Network for Food and Obesity/ non-communicable diseases Research, Monitoring and Action Support) aims to monitor, benchmark and support public and private sector actions to create healthy food environments and reduce obesity and NCDs and their related inequalities. NOURISHING can be used by civil society organisations to monitor what policies are being implemented by governments and by researchers to monitor and evaluate policies.

5. Conclusion

Worldwide, NCDs, including cancer, are the leading cause of death, premature death, ill health and disability. In some countries they have replaced undernutrition and infections as the major causes of death; in others they are an additional burden [149].

In many countries cancer has now replaced CVD as the most common NCD [2, 3]. Cancer carries with it a huge personal burden, not only for those with the disease, but also for their family and carers, and there is often an economic cost of ill health associated with cancer [22, 150].

The prevention of cancer and other NCDs is therefore one of the most significant public health challenges of the 21st century.

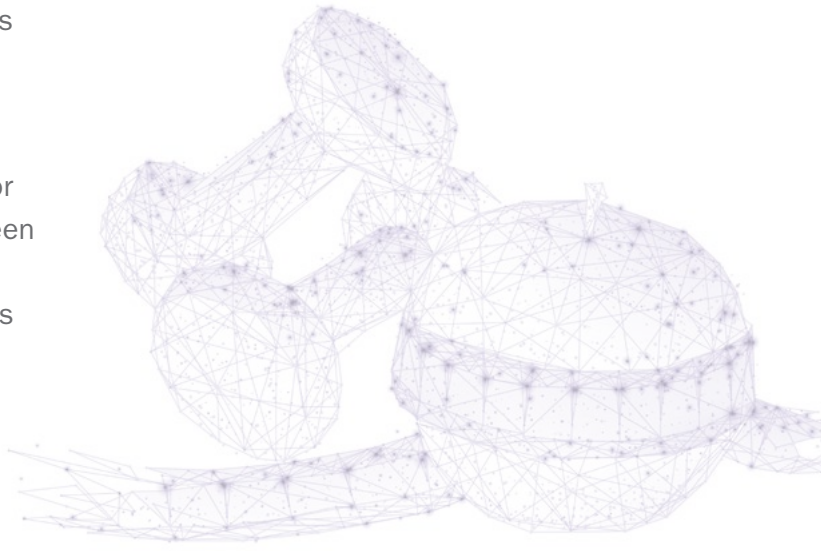
A rational approach to the prevention of cancer requires an understanding of its causes and the behaviours that affect whether or not people are exposed to certain risk factors. Equally, it requires an understanding of the upstream determinants of people's behaviour – the factors that prompt people to behave as they do – and how to influence those factors.

The 10 Cancer Prevention Recommendations describe a way of life that can be confidently expected to reduce the risk of cancer and other diet-related NCDs. The Panel is confident that each of the Recommendations addresses one of the causes of cancer.

However, the Recommendations are not be followed in isolation – each has relevance for the others, and there are interactions between the exposures they address. Therefore, it is prudent to consider all 10 Recommendations as a prescription for an overall way of living. The Panel judges that most benefit will be gained from following as far as possible all the Recommendations together. There is good evidence that the greater the degree of adherence to the 10 Recommendations, the greater the impact on reducing the risk of cancer and other NCD causes of death.

Although people must take on the responsibility to follow the Recommendations, many factors that influence their behaviour are outside their control. The role of public policy in creating environments for people and communities that are conducive to following the Cancer Prevention Recommendations is therefore critically important and requires a comprehensive whole-of-government, whole-of-society approach.

Important actions are being taken in countries around the world, but the rising rates of overweight, obesity and cancer demonstrate that action to date has been insufficient. More concerted action is needed to achieve the global target of reducing premature deaths from NCDs, including cancer, by 25 per cent by 2025 and achieving the related Sustainable Development Goals. The evidence-based Recommendations can help direct, shape and stimulate the required concerted action to benefit all.



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Abbreviations

AICR	American Institute for Cancer Research
BMI	Body mass index
CHD	Coronary heart disease
CUP	Continuous Update Project
CVD	Cardiovascular disease
DNA	Deoxyribonucleic acid
IARC	International Agency for Research on Cancer
INFORMAS	International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support
NCD	Non-communicable disease
SLR	Systematic literature review
WCRF	World Cancer Research Fund
WHO	World Health Organization

Glossary

Absorption
The movement of nutrients and other food constituents from the gut into the blood.

Adenocarcinoma
Cancer of glandular epithelial cells.

Adipose tissue
Body fat. Tissue comprising mainly cells containing triglyceride (adipocytes). It acts as an energy reserve, provides insulation and protection, and secretes metabolically active hormones.

Adiposity
Degree of body fatness; can be measured indirectly in a variety of ways including body mass index (see **body mass index**) and percentage body fat.

Aerobic physical activity/exercise
Relating to or denoting exercise taken to improve the efficiency of the body's cardiovascular system in absorbing and transporting oxygen.

Aerodigestive cancers
Cancers of the organs and tissues of the respiratory tract and the upper part of the digestive tract (including the lips, mouth, tongue, nose, throat and oesophagus).

Aflatoxins
Naturally occurring mycotoxins that are produced by many species of Aspergillus, a fungus, most notably Aspergillus flavus and Aspergillus parasiticus. Aflatoxins are toxic and carcinogenic to animals, including humans.

Alcohol
An organic compound that contains a hydroxyl group bound to a carbon atom. Releases energy when metabolised in the body. Commonly ethanol C6H5OH.

Anthropometric measures
Measures of body dimensions.

Basal metabolic rate (BMR)
The amount of energy required to maintain the essential body functions in resting and fasting conditions, expressed as megajoules, kilojoules or kilocalories per minute, hour or day.

Basal metabolism
The minimum amount of energy required to maintain vital functions at complete rest, measured by the basal metabolic rate in a fasting individual who is awake and resting in a comfortably warm environment.

Bioactive constituents
Compounds that have an effect on a living organism, tissue or cell. In nutrition, bioactive compounds are distinguished from nutrients.

Biological mechanisms
System of causally interacting processes that produce one or more effects.

Biomarker
A naturally occurring molecule, gene or characteristic by which a particular pathological or physiological process can be identified.

Body composition
The composition of the body in terms of the relative proportions of water and adipose and lean tissue. Can also be described as the proportions of fat (lipid) and fat-free mass. May also include the content of micronutrients, such as iron, and the distribution of adipose tissue, for example, central/peripheral or visceral/subcutaneous.

Body mass index (BMI)
Body weight expressed in kilograms divided by the square of height expressed in metres (BMI = kg/m^2). Provides an indirect measure of body fatness.

Caecum
A pouch connected to the junction of the small and large intestines.

Caffeine
An alkaloid found in coffee, tea, kola nuts, chocolate and other foods that acts as a stimulant and a diuretic.

Calcium
An essential nutrient for many regulatory processes in all living cells, in addition to playing a structural role in the skeleton. Calcium plays a critical role in the complex hormonal and nutritional regulatory network related to vitamin D metabolism, which maintains the serum concentration of calcium within a narrow range while optimising calcium absorption to support host function and skeletal health.

Carbohydrate
Type of organic compound of sugars and an essential intermediate in the conversion of food to energy. A dietary micronutrient that releases energy when metabolised in the body.

Carcinogen
Any substance or agent capable of causing cancer.

Carcinoma
Malignant tumour derived from epithelial cells, usually with the ability to spread into the surrounding tissue (invasion) and produce secondary tumours (metastases).

Cardia stomach cancer
A sub-type of stomach cancer that occurs in the cardia, near the gastro-oesophageal junction

Carotenoids
A diverse class of compounds providing colour to many plants. Carotenoids are often classified in two groups: as those providing the host with vitamin A, such as beta-carotene, and the non-pro-vitamin A carotenoids, such as lycopene, which provides the familiar red colour of tomatoes.

Chronic
Describing a condition or disease that is persistent or long lasting.

Cirrhosis
A condition in which normal liver tissue is replaced by scar tissue (fibrosis), with nodules of regenerative liver tissue.

Cohort study
A study of a (usually large) group of people whose characteristics are recorded at recruitment (and sometimes later) and followed up for a period of time during which outcomes of interest are noted. Differences in the frequency of outcomes (such as disease) within the cohort are calculated in relation to different levels of exposure to factors of interest – for example, tobacco smoking, alcohol consumption, diet and exercise. Differences in the likelihood of a particular outcome are presented as the relative risk, comparing one level of exposure with another.

Colon
Part of the large intestine extending from the caecum to the rectum.

Diet, nutrition and physical activity
In the CUP, these three exposures are taken to mean the following: **diet**, the food and drink people habitually consume, including dietary patterns and individual constituent nutrients as well as other constituents, which may or may not have physiological bioactivity in humans; **nutrition**, the process by which organisms obtain energy and nutrients (in the form of food and drink) for growth, maintenance and repair, often marked by nutritional biomarkers and body composition (encompassing body fatness); and **physical activity**, any body movement produced by skeletal muscles that requires energy expenditure.

Dietary fibre
Constituents of plant cell walls that are not digested in the small intestine. Several methods of analysis are used, which identify different components. The many constituents that are variously included in the definitions have different chemical and physiological features that are not easily defined under a single term. The different analytical methods do not generally characterise the physiological impact of foods or diets. Non-starch polysaccharides are a consistent feature and are fermented by colonic bacteria to produce energy and short chain fatty acids including butyrate. The term ‘dietary fibre’ is increasingly seen as a concept describing a particular aspect of some dietary patterns.

Dietary supplement
A substance, often in tablet or capsule form, which is consumed in addition to the usual diet. Dietary supplements typically refer to vitamins or minerals, though phytochemicals or other substances may be included.

Dose–response
A term derived from pharmacology that describes the degree to which an association or effect changes as the level of an exposure changes, for instance, intake of a drug or food.

Energy
Energy, measured as calories or joules, is required for all metabolic processes. Fats, carbohydrates, proteins and alcohol from foods and drinks release energy when they are metabolised in the body.

Energy balance
The state in which the total energy absorbed from foods and drink equals total energy expended, for example, through basal metabolism and physical activity. Also the degree to which intake exceeds expenditure (positive energy balance) or expenditure exceeds intake (negative energy balance).

Epithelial (see **epithelium**)

Epithelium
The layer of cells covering internal and external surfaces of the body, including the skin and mucous membranes lining body cavities such as the lung, gut and urinary tract.

Essential nutrient
A substance that is required for normal metabolism that the body cannot synthesise at all or in sufficient amounts, and thus must be consumed.

Ethanol
An organic compound in which one of the hydrogen atoms of water has been replaced by an alkyl group. See **alcohol**.

Exposure
A factor to which an individual may be exposed to varying degrees, such as intake of a food, level or type of physical activity, or aspect of body composition.

Fat
Storage lipids of animal tissues, mostly triglyceride esters. See **adipose tissue**.

Fatty acid
A carboxylic acid with a carbon chain of varying length, which may be saturated (no double bonds) or unsaturated (one or more double bonds). Three fatty acids attached to a glycerol backbone make up a triglyceride, the usual form of fat in food and adipose tissue.

Folate
A salt of folic acid. Present in leafy green vegetables, peas and beans, and fortified breads and cereals.

Genotoxic
Referring to chemical agents that damage the genetic information within a cell, causing mutations, which may lead to cancer.

Glucose
A six-carbon sugar, the main product of photosynthesis, that is a major energy source for metabolic processes. It is broken down by glycolysis during cellular respiration.

Glycaemic index
A measure of the increase in blood glucose (and insulin) after consumption of a standard amount of a food under controlled conditions.

Glycaemic load
The product of multiplying the glycaemic index by the amount of carbohydrate in a food as consumed. The glycaemic load of a diet takes into account the calculated aggregate of the glycaemic loads of the foods constituting that diet.

Haem
The part of the organic molecule haemoglobin in red blood cells containing iron to which oxygen binds for transport around the body.

Helicobacter pylori (H. pylori)
A gram-negative bacterium that lives in the human stomach. It colonises the gastric mucosa and elicits both inflammatory and lifelong immune responses.

Hepatitis
Inflammation of the liver, which can occur as the result of a viral infection or autoimmune disease, or because the liver is exposed to harmful substances, such as alcohol.

High-income countries
As defined by the World Bank, countries with an average annual gross national income per capita of US$12,236 or more in 2016. This term is more precise than and used in preference to 'economically developed countries'.

Hormone
A substance secreted by specialised cells that affects the structure and/or function of cells or tissues in another part of the body.

Immune response
The production of antibodies or specialised cells, for instance, in response to foreign proteins or other substances.

Immune system
Complex network of cells, tissues, and organs that work together to defend against external agents such as microorganisms.

Incidence
Frequency of occurrence of new cases of a disease in a particular population during a specified period.

Incidence rates
The number of new cases of a condition appearing during a specified period of time expressed relative to the size of the population; for example, 60 new cases of breast cancer per 100,000 women per year.

Inflammation
The immunologic response of tissues to injury or infection. Inflammation is characterised by accumulation of white blood cells that produce several bioactive chemicals (cytokines), causing redness, pain, heat and swelling. Inflammation may be acute (such as in response to infection or injury) or chronic (as part of several conditions, including obesity).

Insulin
A protein hormone secreted by the pancreas that promotes the uptake and utilisation of glucose, particularly in the liver and muscles. Inadequate secretion of, or tissue response to, insulin leads to diabetes mellitus.

Iron-deficiency anaemia
Anaemia caused by a lack of iron. Anaemia is defined as a decrease in the number of red blood cells or the amount of haemoglobin in the blood.

Isoflavones
Constituent of plants with oestrogen-like properties.

Lactation
The production and secretion of milk by the mammary glands.

Less developed regions
As defined by IARC, all regions of Africa, Asia (excluding Japan), Latin America and the Caribbean, Melanesia, Micronesia and Polynesia.

Life course approach
The long-term effects on later health or disease risk of physical or social exposures during pre-conception, gestation, childhood, adolescence, young adulthood and later adult life.

Low-income countries
As defined by the World Bank, countries with an average annual gross national income per capita of US$1,005 or less in 2016. This term is more precise than and used in preference to 'economically developing countries'.

Macronutrient
The components of the diet that provide energy: protein, carbohydrate and fat.

Malignant
A tumour with the capacity to spread to surrounding tissue or to other sites in the body.

Mediterranean type diet/dietary pattern
It generally describes a diet rich in fruits and vegetables, with modest amounts of meat and dairy, some fish and wine, and rich in unrefined olive oil. Traditionally it is also associated with moderate to high levels of physical activity. Currently most countries around the Mediterranean do not consume such a diet.

Melanoma
Malignant tumour of the skin derived from the pigment-producing cells (melanocytes).

Menopause
The cessation of menstruation.

Metabolism
The sum of chemical reactions that occur within living organisms.

Metabolites
Various compounds that take part in or are formed by chemical, metabolic reactions.

Micronutrient
Vitamins and minerals present in foods and required in the diet for normal body function in small quantities conventionally of less than 1 gram per day.

Mutation
A permanent change in the nucleotide sequence of the genome (an organism's complete set of DNA).

Mycotoxins
Naturally occurring toxins produced by fungi, which grow on a variety of crops and foods, often under warm and humid conditions. They can cause a number of acute and chronic illnesses in humans and other animals.

N-nitroso compound
A substance that may be present in foods treated with sodium nitrate, particularly processed meat and fish. It may also be formed endogenously, for example, from haem and dietary sources of nitrate and nitrite. N-nitroso compounds are known carcinogens.

Non-communicable diseases (NCDs)
Diseases which are not transmissible from person to person. The most common NCDs are cancer, cardiovascular disease, chronic respiratory diseases, and diabetes.

Nutrient
A substance present in food and required by the body for maintenance of normal structure and function, and for growth and development.

Nutrition
Process by which organisms obtain energy and nutrients (in the form of food and drink) for growth, maintenance and repair.

Nutrition transition
The phenomenon whereby patterns of food consumption and physical activity in low- and middle-income countries shift from traditional ways of life and plant-based diets low in processed foods to more Western diets with more processed foods high in sugars and fat, more food from animal sources, less physical activity and more sedentary time. These patterns contribute to escalating rates of overweight, obesity and non-communicable disease.

Obesity
Excess body fat to a degree that increases the risk of various diseases. Conventionally defined as a BMI of 30 kg/m^2 or more. Different cut-off points have been proposed for specific populations.

Oestrogen
The female sex hormones, produced mainly by the ovaries during reproductive life and also by adipose tissue.

Osteoporosis
A disease in which the density and quality of bone are reduced.

Pharyngeal cancer
Cancer of the pharynx includes tumours of the nasopharynx, the oropharynx (including tonsils) and the hypopharynx.

Physical activity
Any movement using skeletal muscles that requires more energy than resting.

Phytochemicals
Non-nutritive bioactive plant substances that may have biological activity in humans.

Policy
A course of action taken by a governmental body including, but not restricted to, legislation, regulation, guidelines, decrees, standards, programmes and fiscal measures. Policies have three interconnected and evolving stages: development, implementation and evaluation. Policy development is the process of identifying and establishing a policy to address a particular need or situation. Policy implementation is a series of actions taken to put a policy in place, and policy evaluation is the assessment of how the policy works in practice.

Prevalence
The total number of individuals who have a characteristic, disease or health condition at a specific time, related to the size of the population, for example, expressed as a percentage of the population.

Processed meat
Meats transformed through salting, curing, fermentation, smoking or other processes to enhance flavour or improve preservation (see Exposures: Meat, fish and dairy products).

Protein
Polymer of amino acids linked by peptide bonds in a sequence specified by mRNA with a wide variety of specific functions including acting as enzymes, antibodies, storage proteins and carrier proteins.

Reactive oxygen species (ROS)
Oxygen-containing radical species or reactive ions that can oxidise DNA (remove electrons), for example, hydroxyl radical (OH–), hydrogen peroxide (H_2O_2) or superoxide radical (O^2–).

Rectum
The final section of the large intestine, terminating at the anus.

Resilience
Property of a tissue or of a body to resume its former condition after being stressed or disturbed.

Saturated fatty acids
Fatty acids that do not contain any double bonds.

Satiety
The lack of desire to start eating.

Squamous cell carcinoma
A malignant cancer derived from squamous epithelial cells.

Systematic literature review (SLR)
A means of compiling and assessing published evidence that addresses a scientific question with a predefined protocol and transparent methods.

Tumorigenesis
The process of tumour development.

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Appendix 1: Findings of other reports

Recommendations to prevent food-related diseases

The assessments and judgements made by the Panel are based on evidence from the CUP – from systematic literature reviews of original research studies, compiled according to specified criteria, on diet, nutrition, physical activity and risk of cancer. The Panel recognises that recommendations on diet, nutrition and physical activity are also made in relation to other diseases. These include recommendations designed to control and prevent chronic diseases other than cancer and those designed to influence the dietary and activity patterns of populations and individuals.

The Panel's task when developing the Cancer Prevention Recommendations was to formulate integrated Recommendations and messages that consider all parts of the world and take into account other recommendations for nutritional adequacy and chronic diseases other than cancer.

A systematic literature review commissioned for the 2007 Second Expert Report identified 95 reports from 49 organizations that were published from 1990 to 2005 and met pre-specified inclusion criteria (see Chapter 10 of the 2007 Second Expert Report [151]). The Panel was impressed by the similarity of the conclusions and recommendations in all types of expert reports reviewed.

Rather than commission an update to the SLR, the Panel opted to take a streamlined approach, using its expertise to identify recent and relevant reports addressing diet, nutrition, physical activity and the prevention of CVD, type 2 diabetes, osteoporosis and iron-deficiency anaemia. Dietary guidelines for populations were also identified and taken into account.

Table 1 summarises recommendations for the prevention of NCDs. Recommendations related to cancer are not included.

Table 1: Summary of recommendations for the prevention of other NCDs

Exposure	Recommendations	To prevent
Cereals (grains), roots, tubers and plantains	Choose fibre-rich wholegrains for most grain servings	CVD [63, 152]
Vegetables, fruit, pulses (legumes), nuts, seeds, herbs and spices	Suggested intake of 2 to 3 servings of fruit per day, 2 to 3 servings of vegetables per day, and 30 grams of unsalted nuts per day	CVD [63]
	Include legumes in the diet to improve overall iron intake	Iron-deficiency anaemia [92]
Fibre	Include sufficient consumption of dietary fibre	CVD [63]
Meat, fish and eggs	Include fish one to two times per week, one of which should be oily fish	CVD [63]
	Include small portions of meat, poultry or fish to increase the iron content of a diet	Iron-deficiency anaemia [92]
	Include meat, chicken, fish and eggs in diet	Included in national dietary guidelines for many countries [154]
Fats and oils	Limit intake of saturated fatty acids to less than 10 per cent of total energy intake	CVD [63]
	Avoid consuming trans-unsaturated fatty acids	Type 2 diabetes mellitus [152, 153]
		CVD [63, 152]
Salt and sugar	Restrict salt intake to less than 5 grams per day	CVD [155]
	Choose foods with less sodium and prepare foods with little or no salt	CVD [152]
	Limit or cut back on beverages and foods with added sugars	Type 2 diabetes mellitus [88]
Milk and dairy products	Include milk and dairy products daily, preferably low-fat versions	Included in national dietary guidelines for many countries [154]
Water, fruit juices, soft drinks and hot drinks	Discourage consumption of sugar sweetened beverages	Type 2 Diabetes mellitus and weight gain [88]
		CVD [63]
Alcoholic drinks	Limit or discourage consumption of alcoholic drinks	CVD [63] Osteoporosis [156]
Food production, processing, preservation and preparation	Cook vegetables rich in vitamin C, folate and other water-soluble or heat-labile vitamins minimally in small amounts of water in order to enhance iron absorption	Iron-deficiency anaemia [92]

Exposure	Recommendations	To prevent
Dietary constituents and supplements	Iron and folic acid supplementation may be needed to ensure adequate levels in areas with widespread prevalence of iron deficiency anaemia	Iron-deficiency anaemia [92]
	Ensure adequate calcium intake and adequate supply of vitamin D, including supplements if diet is insufficient	Osteoporosis [68, 156, 157]
Dietary patterns	Healthy eating pattern – follow a healthy eating pattern across the lifespan	CVD, diabetes, overweight and obesity [75, 152]
	Exclusive breastfeeding for infants for first 6 months of life	Protection against chronic diseases [144]
Physical activity	At least 150 minutes a week of moderate-intensity physical activity, such as brisk walking (additional benefits occur with more physical activity)	CVD [63, 158] Type 2 diabetes mellitus [153]
	Regular weight-bearing and muscle-strengthening exercise to improve agility, strength, posture and balance	Bone health [68, 158]
Weight gain, overweight and obesity	Achieve and maintain a healthy weight	CVD, Type 2 diabetes mellitus [63]

Food-based dietary guidelines:

Food-based dietary guidelines have been developed by national expert committees in more than 100 countries and these can be accessed from the website of the Food and Agriculture Organization of the United Nations.

www.fao.org/nutrition/education/food-dietary-guidelines/regions/en
(accessed 8 December 2016)

Overall the recommendations are remarkably consistent with each other and with the Cancer Prevention Recommendations:

- Nearly all countries recommend eating a variety of foods and including fruit and vegetables in the daily diet.
- Many countries recommend being physically active every day.
- Many countries recommend being a healthy body weight.
- Several countries recommend including meat and animal products in the diet to help prevent iron-deficiency anaemia. A few countries recommend limiting consumption of red meat.
- Most countries recommend that alcohol consumption be limited or avoided.
- Most countries recommend that salt consumption be limited.

Appendix 2: Policy options to address diet, physical activity, breastfeeding and alcohol consumption using an adapted policy framework

In **Section 4**, the NOURISHING framework [135] was presented and adapted to illustrate how a new policy framework can be used to influence physical activity, alcohol consumption and breastfeeding, in addition to diet, as these factors share common policy levers. Broadly, these policy levers influence availability, affordability, awareness and acceptability.

Using the new framework (**Figure 2** in **Section 4**), **Table 2** outlines an exemplar of this approach and categorises selected policy options for the four different risk factors for cancer, across the ***11 broad policy areas*** (labelling and packaging; create healthy and safe schools, workplaces, public institutions and health facilities; fiscal policies; marketing restrictions; improve the food and drink supply; incentives in communities; integrate actions across sectors; healthy urban design; inform people; counselling in health care; education and skills) and ***three domains*** (health-enhancing environments, systems change and behaviour change communication). The policy options are drawn from existing strategies, frameworks and plans [18, 136–144]. This helps frame the policies that are needed to create environments for people and communities that are conducive to leading healthier lives and following all of the Cancer Prevention Recommendations.

In general, the policy options outlined in the table are more effective when mandatory. For example, self-regulation by industry has been ineffective at reducing the exposure of children to the marketing of unhealthy food and drink [159].

Table 2: Example policy options[1] to promote healthy diets, physical activity, breastfeeding and reduce alcohol consumption, overweight, obesity and cancer, drawn from existing strategies, frameworks and plans [18, 136–144]*

Note: Policy options need to be mindful of trade law obligations. Not all policy options outlined in the table are supported by the same level of evidence.

	Diet	Alcohol	Physical activity	Breastfeeding[2]
Health-enhancing environments	(Food and drink environment)	(Food and drink environment)	(Built environment)	(Environments that support breastfeeding)
Labelling and packaging	• Nutrient lists on packaged food • Clearly visible interpretive nutrition labels and warning labels on packaged foods • Calorie and nutrient labelling on menus and displays in out-of-home venues • Rules on nutrient claims and health claims on packaged food	• Labels describing alcohol content (per cent of pure alcohol) • Labels describing calories, ingredients and serving sizes • Prominent, clearly worded warning labels on drinks to indicate alcohol-related harm	• Prompts and cues in the environment to promote movement (e.g. signage to encourage stair use, signage for parks)	• Labels on breastmilk substitutes on the appropriate use of the product, so as not to discourage breastfeeding • Labels on breastmilk substitutes to include a statement of the superiority of breastfeeding, a statement that the product should be used only on the advice of a health worker and instructions for appropriate preparation • Labels on breastmilk substitutes warning consumers that use can reduce breastfeeding, which has been linked to increased risk of cardiovascular disease and certain types of cancers in women • Plain (unbranded) packaging with no marketing claims

[1] The table provides an overview and is not an exhaustive list of all policy options.
[2] Policies are needed to promote, protect and support breastfeeding; however, we recognise that not all mothers are able to breastfeed.
* Special thanks to David Jernigan, Jo Salmon, Lucy Sullivan and Lucy Westerman who provided specific feedback on the **Appendix 2** Table.

	Diet	Alcohol	Physical activity	Breastfeeding[2]
Healthy and safe schools, workplaces, public institutions and health facilities	• Nutrition standards for food and drink available in preschools, primary, secondary and tertiary schools • Fruit and vegetable initiatives in schools • Bans specific to vending machines in schools • Nutrition standards for food and drink available in workplaces, health facilities and public institutions • Nutrition standards in social support programmes	• Restrictions on alcohol consumption in educational buildings, workplaces and health facilities	• Initiatives that optimise opportunities for physical activity (including walking and cycling to and from school) and active play, before and after school, during recess and lunch breaks, and reduce sitting during class lessons • School design guidelines that ensure adequate provision of accessible and safe environments for children to be physically active (e.g. play areas, recreational spaces), reduce sitting (e.g. activity permissive classrooms) and support walking and cycling to and from educational institutions • Multi-component workplace physical activity programmes • Labour and workplace policies that support physical activity • Infrastructure that facilitates activity by providing appropriate end of trip facilities (e.g. showers, bike racks) • Computer prompts and signage on desks in the workplace and schools to break up sitting	• Implementation or expansion of the baby-friendly hospital initiative in health systems • Maternity protection legislation, including mandatory paid maternity leave • Policies that encourage and support women to breastfeed in the workplace and in public (e.g. lactation rooms, nursing breaks)
Fiscal policies	• Health-related taxes, e.g. on sugary drinks and unhealthy foods • Increased/ decreased import tariffs on specified foods • Targeted subsidies for healthy food • Incentives to support agricultural systems changes	• Excise taxes on alcoholic drinks, graduated by volume of ethanol, that are reviewed regularly • Minimum pricing for alcoholic drinks sold in retail establishments and licensed premises	• Incentives, tax deductions and targeted subsidies to support participation in physical activity (e.g. increase access to recreation facilities) • Parking and public transport policies that encourage active transport • Tax incentives to encourage workplaces to implement active travel policies for staff to use alternative forms of transport • Congestion charges and fuel levies	• Maternity leave cash benefit

	Diet	Alcohol	Physical activity	Breastfeeding[2]
Marketing restrictions	• Restrictions on all forms of food and drink marketing to children, including advertising, promotion and sponsorship • Restrictions of all forms of food and drink marketing in schools, including advertising, promotion and sponsorship	• Bans or restrictions on alcohol marketing and advertising across all types of media and sponsorship, particularly marketing that reaches large numbers of youth and other vulnerable populations • Restrictions on alcohol promotion in educational buildings, workplaces and health facilities	• Regulations on the marketing of products, environments and behaviours that encourage sedentary behaviour • Restrictions on sport partnerships and sponsorships with unhealthy products	• Legislation to end inappropriate marketing of baby feeding products in line with the International Code of Marketing of Breast-milk Substitutes and subsequent resolutions • Legislation to end inappropriate marketing of complementary foods
Improve the food and drink supply	• Limits on salt and requirements for removal of trans fats in food products • Limits on availability of high-fat meat products • Initiatives to increase the fibre and wholegrain content of food products in the overall food supply • Initiatives to increase the sustainability of food production	• Limits on the amount of alcohol in products (e.g. ready drinks, beer, wine) • Limits on additives to alcoholic drinks, such as stimulants like caffeine and taurine	• N/A	• Policies to increase the availability of appropriate, diversified, nutrient-dense foods for complementary feeding and for breastfeeding women • Limits on salt and sugar and requirements for removal of trans fats in infant and toddler food and drink

	Diet	Alcohol	Physical activity	Breastfeeding[2]
Incentives in communities	• Initiatives to increase the availability of healthier foods in stores and food service outlets • Incentives and regulations to reduce 'less healthy' food and ingredients in food service outlets	• Licensing system on retail sales or public health oriented government monopolies on the production and/or sale of alcohol • Restrictions on drinking in public spaces • Restrictions on days and hours of sale of alcohol • Restrictions on purchase of alcohol at petrol stations	• Community walking and cycling programmes • Sport and recreation policies that create active opportunities for everyone • Incentives and rules to make safe spaces for physical activity (e.g. improved lighting), including recreation and public and active transport	• Community-based interventions, including group counselling or education • Home visits by public health nurse or midwife soon after birth to promote, protect and support breastfeeding
Healthy urban design	• Planning restrictions on food outlets • Incentives and rules for stores to locate in underserved neighbourhoods (e.g. healthier retail outlets)	• Restrictions on density of on-premise and off-premise alcohol outlets and integration of public health considerations into relevant planning laws	• Transport planning policies, systems and infrastructure that prioritise walking, cycling and use of public transport • Urban design regulations and infrastructure that provide convenient, safe and affordable access to quality public open space • Policies that increase access to fresh quality fruit and vegetables in local areas that can be easily accessed by foot, bicycle or public transport • Land use and urban policies that require city and regional designs to incorporate residential density, connected street networks that include sidewalks, easy access to a diversity of destinations and access to public transport	• Policies that encourage and support women to breastfeed in public • Nursing stations in public facilities such as airports, train stations, parks, etc.

	Diet	Alcohol	Physical activity	Breastfeeding[2]
Systems change				
Integrate actions across sectors	• Nutrition standards for public procurement • Public procurement through 'short' chains (e.g. local farmers) • Supply chain incentives for food production (e.g. stimulating markets for healthier foods) • Governance structures for multisectoral/ stakeholder engagement	• Drink-driving laws and blood alcohol concentration limits through sobriety checkpoints • An appropriate minimum age for purchase or consumption of alcoholic drinks • Governance structures for multisectoral/ stakeholder engagement to harmonise alcohol policies across government sectors	• Cross-level government working groups including representatives from national, regional and local levels of government to implement action plans at each level synergistically • Policies that ensure adequate access to, and use of, natural environments for physical activity, recreation and play	• Governance structures for multisectoral/ stakeholder engagement
Behaviour change communication				
Inform people	• Development and communication of food-based dietary guidelines • Public awareness campaigns on healthy eating • Public awareness campaigns concerning specific unhealthy food and drink	• Public awareness campaigns about risks of alcohol consumption and cancer • Development and communication of 'lower-risk' drinking guidelines	• Development and communication of physical activity guidelines • Sustained, community-wide education and public awareness campaigns using traditional and social media and social marketing techniques to promote and increase understanding of the diverse ways everyone can be active, as well as increase understanding of the risks of physical inactivity and sedentary behaviour • Public awareness communications about places to be physically active	• Community-based communication campaigns to promote, protect and support exclusive breastfeeding for the first 6 months of life, tailored to the local context • Mass media and social media campaign on breastfeeding

	Diet	Alcohol	Physical activity	Breastfeeding[2]
Counselling in health care	• Nutrition counselling in primary care • Nutrition training for health professionals	• Prevention, routine screening, treatment and care for alcohol use in health services • Brief psychosocial interventions for persons with hazardous and harmful alcohol use	• Development of simplified guidelines and protocols for integrating physical activity assessment and promotion in healthcare settings, including screening for physical activity in all health checks • Physical activity counselling and referral as part of routine primary health care services	• Promotion, protection and support of exclusive breastfeeding for the first 6 months of life, and continued breastfeeding for 2 years and beyond in conjunction with appropriate complementary foods • Organisation of care to enable counselling on infant and young child feeding • Individual counselling or group education, immediate breastfeeding support at delivery, and lactation management • Breastfeeding counselling in antenatal and postnatal care
Education and skills	• Food and nutrition education, including food preparation and cooking skills in school core curricula • Training for caterers and food service providers	• Mandated training in responsible beverage service for servers and managers where alcohol is served	• Mandated high-quality physical education in school curricula delivered by trained physical educators, that focuses on life-long engagement in physical activity and sport, mastery of fundamental movement and sport skills, and physical literacy • Enhanced physical activity training for all teachers • Tools and educational strategies to embed active-living principles into the practices of built-environment professionals (architects, urban planners) • Strengthened knowledge and awareness in key professional sectors (e.g. health professionals) of their role and impact on influencing and enabling participation in physical activity	• Training and capacity building for health workers in breastfeeding protection, promotion and support • Integration of infant and young child feeding into curricula for all first-level health workers

Our Cancer Prevention Recommendations

Be a healthy weight
Keep your weight within the healthy range and avoid weight gain in adult life

Be physically active
Be physically active as part of everyday life – walk more and sit less

Eat a diet rich in wholegrains, vegetables, fruit and beans
Make wholegrains, vegetables, fruit, and pulses (legumes) such as beans and lentils a major part of your usual daily diet

Limit consumption of 'fast foods' and other processed foods high in fat, starches or sugars
Limiting these foods helps control calorie intake and maintain a healthy weight

Limit consumption of red and processed meat
Eat no more than moderate amounts of red meat, such as beef, pork and lamb. Eat little, if any, processed meat

Limit consumption of sugar sweetened drinks
Drink mostly water and unsweetened drinks

Limit alcohol consumption
For cancer prevention, it's best not to drink alcohol

Do not use supplements for cancer prevention
Aim to meet nutritional needs through diet alone

For mothers: breastfeed your baby, if you can
Breastfeeding is good for both mother and baby

After a cancer diagnosis: follow our Recommendations, if you can
Check with your health professional what is right for you

Not smoking and avoiding other exposure to tobacco and excess sun are also important in reducing cancer risk.

Following these Recommendations is likely to reduce intakes of salt, saturated and trans fats, which together will help prevent other non-communicable diseases.

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