

EDITORIAL

SOUTH AFRICAN FOOD-BASED DIETARY GUIDELINES

The massive global burden of diet-related diseases and the growing perception that nutrient-based dietary guidelines are not effective in promoting appropriate diets and healthy lifestyles have motivated a number of countries and regions to develop food-based dietary guidelines (FBDGs). In this issue of the journal, the South African FBDGs are defined and motivated in technical support papers for nutrition scientists and professionals. A working group representing different stakeholders developed the guidelines over a period of 4 years. The process recommended by a joint FAO/WHO expert consultation was followed.

The guidelines can now be used as a consistent communication tool because they represent expert agreement on how diet-related public health problems should be addressed by dietary recommendations to consumers. But they can also be used as basis in the planning, implementation and evaluation of public health nutrition strategies. National adoption and use of these guidelines will show a political will to tackle nutrition-related health problems.

The South African Working Group should be commended for developing one set of guidelines aimed at optimal nutrition for all South Africans 5 years and older, and without special dietary needs. The technical support papers indicate how each guideline was formulated to address existing under- and overnutrition in different communities. They further emphasise that the guidelines were based on existing eating patterns and are commensurate with the various South African dietary cultures. Clearly the guidelines demonstrate the striving towards equity in diet and health, aiming to optimise nutritional status in both disadvantaged and affluent communities. The nutrition transition in many developing countries has been characterised by a transition from under- to overnutrition. The set of South African FBDGs embodies principles and concepts and makes recommendations to help prevent this phenomenon.

The working group can also be commended because at this stage the guidelines have already been tested for comprehension, appropriateness and applicability in consumer groups of different communities. This shows a scientific approach which will assist in the implementation of the guidelines.

Implementation is the next challenge. The availability of adequate resources is a prerequisite. To be successful, it is recommended that a structured approach should be followed

in developing a framework and strategies appropriate for the South African situation.

It is now generally accepted that to be effective, dietary interventions (such as implementation of the FBDGs at a population level) should be comprehensive, population-based, integrated, multidisciplinary and multisectorial. Therefore, implementation should involve a complementary range of actions, from policy, environmental, community and individual levels. The challenge is to integrate these dietary recommendations into a national plan of action aimed at promoting appropriate diets, physical activity and healthy lifestyles.

The working group based the development of the guidelines on prevailing eating patterns and diet-related health issues. In implementation, existing lifestyles, attitudes, social, economic and environmental issues in different communities should also be taken into account and should direct strategies for specific groups.

South African nutritionists have an advocacy role in ensuring that these FBDGs receive sufficient media and political exposure to be incorporated into health policy. But they also have an educational role in ensuring that all professionals in public health understand the potential of the guidelines to help improve dietary intakes, nutritional status and health, and in the prevention of diet-related diseases. Continuous monitoring of the impact of the guidelines would be necessary to evaluate how successful implementation is. The working group has indicated that the guidelines should be reviewed and adapted regularly, taking into account changes in society and new information about the relationships between nutrition and health. Nutritionists should embrace this task with enthusiasm. The outcomes in improved nutrition, development and health would make this a meaningful and worthwhile task.

Michael Gibney

*Unit of Nutrition and Dietetics
Department of Clinical Medicine
Trinity College Medical School
St James Hospital
Dublin
Ireland*

Hester Vorster

*School of Physiology and Nutrition
Potchefstroom University for CHE
Potchefstroom, N-W*

DEVELOPMENT OF FOOD-BASED DIETARY GUIDELINES FOR SOUTH AFRICA – THE PROCESS

H H Vorster, P Love, C Browne

This paper reviews the motivation behind and the process of development of positive, practical, affordable, sustainable and culturally sensitive food-based dietary guidelines (FBDGs) to help South Africans over the age of 5 years to choose an adequate but prudent diet. The guidelines are based on the existing consumption of locally available foods and aim to address identified nutrition-related public health problems. The FBDGs consist of 10 short, clear and simple messages which have been tested for comprehension, appropriateness and applicability in consumer groups of different ethnic backgrounds in both rural and urban areas.

The guidelines are:

- Enjoy a variety of foods.
- Be active.
- Make starchy foods the basis of most meals.
- Eat plenty of fruit and vegetables.
- Eat dry beans, peas, lentils and soya often.
- Meat, fish, chicken, milk and eggs can be eaten every day.
- Eat fats sparingly.
- Use salt sparingly.
- Drink lots of clean, safe water.
- If you drink alcohol, drink sensibly.

These guidelines will have to be adapted for groups with special dietary needs. It is recommended that the guidelines could and should be used in the Integrated Nutrition Programme and that they could form the basis of nutrition education in South Africa. It is recommended that the guidelines should be regularly reviewed, based on their impact, changes in South African society due to socio-economic transition, and as new knowledge of nutrition-health relationships becomes available.

School of Physiology, Nutrition and Consumer Sciences, Potchefstroom University for CHE, Potchefstroom

H H Vorster, MSc, DSc

Discipline of Dietetics and Human Nutrition, School of Agriculture and Agri-Business, University of Natal, Pietermaritzburg

P Love, BSc Hons, Dipl Dietetics, RD (SA)

South African Sugar Association, Public Affairs, Mount Edgecombe, KwaZulu-Natal

C Browne, BSc, Dipl Dietetics, RD (SA)

One of the goals of the World Declaration and Plan of Action for Nutrition adopted at the 1992 FAO/WHO International Conference on Nutrition in Rome is the global elimination or substantial reduction of malnutrition, micronutrient malnutrition and diet-related communicable and non-communicable disease.¹ A strategy identified to accomplish this goal is the promotion of appropriate nutritional intake and healthy lifestyles.¹ The failure of nutrient-based guidelines to substantially influence dietary patterns of different populations stimulated another FAO/WHO initiative to establish the scientific basis for developing and using food-based dietary guidelines relating to practices and prevailing nutrition-related public health problems.² There has therefore been a change in focus from the traditional attention to nutrients to locally available foods.

Existing guidelines in South Africa are either nutrient-based³ or aimed only at a population eating a typical Western diet.⁴ Motivated by the FAO/WHO initiatives, the Nutrition Society of South Africa (NSSA) decided to form a focus or working group (WG) that could start the process of developing Food-Based Dietary Guidelines (FBDGs), and asked Professor H H Vorster to initiate the process. In a newsletter of the NSSA published in the *South African Journal of Food Science and Nutrition*,⁵ volunteers were invited to serve on the WG to develop FBDGs that would be appropriate for the whole South African population.

CHARACTERISTICS OF FBDGS

As mentioned, FBDGs should be based on locally consumed foods. They should address existing nutrient deficiencies and excesses, and the resulting nutrition-related public health problems of a specific country or community. In order to successfully change eating behaviour, a number of specific characteristics for FBDGs have been identified by the WG, based on the FAO/WHO recommendations. These include the following:

- Each guideline should have only one, easy, understandable, simple message. Guidelines should be formulated or illustrated in such a way that people from different cultures and literacy backgrounds will grasp their meaning.
- They should be 'user-friendly' and not confusing.
- They should be formulated in a positive way. No negative messages using words such as avoid, decrease, limit, cut out or eat less, should be used. The FBDGs should not create guilt feelings about, or negative associations with, foods.
- They should be compatible with the different cultures and eating patterns of the target population.
- They should be based on affordable, available foods which are widely consumed.
- They should be sustainable.

- They should encourage environmentally friendly agriculture.
- They should lead to selection of foods that are usually eaten together — in groupings that are compatible with existing dietary practices.
- They should address both over- and under-nutrition. They should help people to choose the most appropriate diet they can afford – encourage undernourished people to choose a more adequate diet and overnourished people to choose a more prudent diet.
- They should emphasise the joy of eating!
- They should be formulated and communicated to the target population using marketing skills based on the knowledge, perceptions, attitudes and behaviours of the target population.

THE PROCESS OF DEVELOPING FBDGs FOR SOUTH AFRICA

During the first meeting of a group of volunteers on 19 May 1997 in Durban, the terms of reference, mandate, objectives, and composition of a representative WG were defined. The WG agreed that their mandate was to develop a core set of FBDGs to promote health for South Africans older than 5 years of age. The decision to develop separate FBDGs to promote health for South African children younger than 5 years was based on their specific dietary needs for growth and development, and their specific diet-related public health issues, mainly undernutrition.

The key objectives of the WG were to:

- create consensus within the group regarding the role of nutrients and dietary patterns in the public health profiles of South Africans
- test the consumer understanding, appropriateness and applicability of the guidelines
- write scientific support papers for each guideline, motivating its formulation, background and aims
- write an explanatory text on the FBDGs for the layperson for use by consumers and health personnel in nutrition interventions
- advise on how the guidelines should be incorporated into health and agricultural policies
- advise on the implementation and promotion of the guidelines, the development of appropriate education materials and monitoring impact on eating patterns
- adapt the guidelines for groups with special dietary needs
- contribute to a process in which the guidelines are reviewed every 5 years.

The WG decided to follow the process as advised by the FAO/WHO consultation² with adaptations where necessary for local conditions. Members of the WG volunteered to review the

South African literature to identify the nutrition-related public health problems, nutrient intakes of different groups, vulnerable groups, and relevant public health policies.

The second meeting in Pretoria on 22 October 1997 was in the form of a workshop in which a larger, more representative WG participated. Delegates from academia, NSSA, ADSA, the Medical Research Council (MRC), Department of Health, UNICEF, the agricultural sector, food industry and an observer from the FAO intensively debated the solicited reviews on the South African nutritional situation. Consensus was reached on the following realities and assumptions:

- Malnutrition, including under- and overnutrition, is associated with avoidable morbidity and mortality.
- In South Africa, malnutrition contributes to the different patterns of morbidity and mortality of different population groups and communities.
- Many South Africans are experiencing rapid urbanisation and acculturation, characterised by a nutrition transition that often results in both over- and undernutrition; a double burden of nutrition-related diseases is prevalent in many households and communities.
- Different types of ethnic food choices (including the combination of certain foods based on traditional African and Western food intakes) are compatible with good nutrition and health.
- Except for spoiled and contaminated food, there is no such thing as a bad food — only bad diets.
- Many factors influence food choices, and nutritional intake is but one of the controllable lifestyle factors which influence health. Therefore, usual food choices should be evaluated in the context of total lifestyle and living circumstances. In South Africa, socio-economic circumstances have a major influence on food choices and dietary patterns.
- Although South Africa produces enough food for all its inhabitants, and even exports food, many poor households are food insecure, especially in rural areas and in informal housing areas inhabited by people in transition.
- Food safety, mainly because of an increase in street vendors, may become a progressive problem in the future.

Based on the above discussions, a document was compiled indicating the relevant nutritional issues that could lead to a guideline (variety; meals; body weight; exercise and energy; carbohydrates (staples); fibre, vitamins and minerals; proteins; fats and sodium; water and alcohol; smoking and stress). The accompanying nutritional recommendations were indicated and a preliminary FBDG for each, with a motivation, was formulated. The scientific background in the South African context was summarised for each guideline.

This document and other relevant papers were circulated to volunteer participants of the workshop on FBDGs which

formed part of the 1998 Nutrition Congress held on 27 May 1998 at Sun City. Each guideline was discussed during this workshop in terms of its health relevance, scientific evidence, practical application, comprehension, prudence and adequacy.

Based on these discussions, a revised set of guidelines was compiled during a follow-up workshop in Cape Town on 1 August 1998. A protocol for testing these guidelines in a field study was developed and agreed on during a meeting on 18 January 1999 in Durban. The testing was done in focus-group discussions with women from different ethnic groups in rural and urban areas, initially in 2 of the 9 provinces of South Africa. The results of this process were recently reported by Love *et al.*⁶ Discussions were held in the home language of the participants (English, Afrikaans, Zulu and Xhosa). The results of these evaluations were incorporated into the guidelines during a meeting on 18 January 2000 in Durban. During this meeting it was also decided that focus-group discussions would continue in other provinces to ensure that the perceptions of other ethnic groups and cultures would also be accommodated. A decision was taken to form additional WGs to investigate the development of FBDGs for specific priority groups such as HIV/AIDS sufferers, children younger than 5 years, the elderly, and pregnant and lactating women. The steps for writing of supporting texts for each guideline and further discussions with the nutrition community took place during a symposium at the Nutrition Congress in Durban on 15 August 2000.

SPECIFIC PROBLEMS

Because of the complexity of nutrition-health relationships in South Africa's multicultural society, and the goal of having one set of guidelines for all, the development of the guidelines was a daunting task. Many issues, evaluated in depth and based on available evidence, could not be resolved with clear-cut answers. In these instances, the weight of the evidence and the particular South African situation guided the formulation of the guideline. Examples of these issues were the variety guideline, the absence of a separate dairy guideline, and a guideline on the intake of foods from animals.

The results from the testing of the preliminary guidelines⁶ further influenced the formulation and working of the guidelines. The 'variety' guideline debate took into consideration the issue of affordability of variety in poor households, in contrast to the situation in the USA, where the elimination of this guideline was based on its suspected contribution to their obesity problem.⁷ A separate guideline about milk intake was not included, based on affordability, dietary patterns and lactose intolerance in a large part of the South African population. However, the low calcium intakes of many South Africans, the importance of calcium in growth, development and prevention of bone disorders and also

possible prevention of hypertension, were acknowledged and contributed to the formulation of the 'animal food' guideline.

The guideline about intakes of meat, fish, chicken, milk and eggs was difficult to formulate in a positive way to be relevant for all South Africans. The available evidence suggests that during the nutrition transition, when more foods from animals are eaten, nutritional status improves.⁸ The high prevalence of iron deficiency, especially in African children and adolescents, is a sound motivation for increased intakes of especially red meat. However, the convincing evidence that these foods also contribute to an increased saturated fat intake and risk of chronic diseases should not be ignored. Therefore, this particular guideline should be accompanied by nutrition education (information) to recommend optimal daily quantities.

FUNDING OF THE PROCESS

The initial workshops to develop the FBDGs were funded by the South African Sugar Association and the South African Meat Board. Delegates from the food industry, Department of Health, Dry Bean Producers Organisation, the MRC and academia were funded by their own institutions. The evaluation of guidelines in field studies was funded by UNICEF. The FAO and International Life Sciences Institute jointly funded a group of South African delegates to share the South African experience with eleven other African countries during a workshop in Harare in October 1999.

CRITICAL FACTORS FOR SUCCESS

In our review of the South African process, a number of factors which determined the steady progress and output of a set of thoroughly 'filtered' guidelines emerged. The most important is that the WG decided to choose a dedicated chairperson with sufficient time, 'vested interest' and the necessary background knowledge and expertise to lead and drive the process. It was fortunate that a private consultant dietitian, Ms Penny Love, was available as chair, that she could motivate the process as part of her PhD studies and that she could obtain funding for the extensive evaluation process. Another factor was that although limited in certain areas, sufficient information on the public health problems in South Africa, as well as nutrient intakes and dietary patterns of different groups, was available to serve as basis for the FBDGs. Other factors were sufficient funding, funding that allowed a totally objective agenda, the multidisciplinary nature of the WG and the extensive and open discussions during the various workshops. Clearly, these guidelines were developed in a highly participatory and consultative manner.

THE WAY FORWARD

The present set of guidelines has been finalised after evaluation of their comprehension and practicality in different South African ethnic groups. A user-friendly explanatory text for health personnel and the consumer, showing how the application of the guidelines can lead to healthy eating, has been written by Ms Carol Browne (Guidelines for healthy eating for South Africans — unpublished data, 2000). The scientific support papers are published in this supplement of the *South African Journal of Clinical Nutrition*.⁹⁻¹⁸ It should be noted that because ethnic differences in dietary patterns and consequently differences in nutrition-related disease profiles exist, these papers sometimes refer to different ethnic groups in South Africa. However, the guidelines have been developed as one set, to optimise nutritional status of all South Africans. The guidelines have been discussed at a special symposium of the 2000 Nutrition Congress. The next step should be the formulation of a strategy on how the guidelines should be implemented to improve dietary patterns of all South Africans, combined with the development of a protocol for evaluation of implementation and impact of the FBDGs. There are various models available for implementation, focusing on key target groups, key settings and key approaches. The most appropriate ones for the South African situation will require further deliberation. These guidelines could and should be used in the Integrated Nutrition Programme of the Department of Health and should form the basis of nutrition education in the Primary School Nutrition Programme and the national education curriculum of the Department of Education. For successful implementation, there seems to be agreement that modern marketing strategies should be used.

CONCLUDING REMARKS

The development and evolution of these guidelines were characterised by lively debates and discussions. The WG considered each word carefully, and formulated each guideline based on available scientific evidence (or lack thereof) and the accepted characteristics of ideal FBDGs. However, the WG realised that the South African society is a society in transition, and that future nutrition research may reveal more about the relationships between nutrition and health. Therefore, the WG accepts that these FBDGs will have to be reviewed and adapted accordingly on a regular basis.

In the following scientific support papers⁹⁻¹⁸ these aspects, as well as the need for specialised accompanying texts, addressing specific needs and situations of specific target groups during education and implementation, are repeatedly emphasised. In each paper, the main public health problem addressed by a specific guideline is highlighted. However, it should be noted that all the guidelines, in combination, were formulated to address these public health problems collectively.

The core of the working group consisted of a group of enthusiastic, highly skilled volunteers, each contributing her own expertise and experience to the process. We wish to thank them all, as well as the participants of the various workshops and symposia. A special word of thanks to Professor B M Margetts who assisted in designing the protocol for evaluation of the guidelines, and all the fieldworkers and subjects participating in the evaluation process. The members of this group (in alphabetical order) were: Ms Ann Behr, Dr Lesley Bourne, Ms Christine Broadhurst, Ms Carol Browne, Professor Karen Charlton, Ms Penny Love, Ms Joan Matji, Professor Eleni Maunder, Mrs N Maqoma, Ms Cynthia Mngigima-Dladla, Ms Engela van Eyssen, Dr Ingrid van Heerden, Professor HH Vorster, Ms Christa Welgemoed and Dr Petro Wolmarans.

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ENJOY A VARIETY OF FOODS — DIFFICULT BUT NECESSARY IN DEVELOPING COUNTRIES

E M W Maunder, J Matji, T Hlatshwayo-Molea

'Enjoy a variety of foods' is the first of the ten South African Food-Based Dietary Guidelines (FBDGs). This guideline attempts to focus on some of the consequences arising from a lack of dietary variety. Its aim is to encourage people to change their diets where necessary so as to increase the variety of foods eaten and to enjoy their food. The guideline needs to be understood in the context of the other FBDGs and to be applied with the assistance of appropriate food guides.

For both consumers and nutritional scientists, variety is conceptualised as including different foods and different food groups as part of the diet, as well as altering the method of food preparation. In addition, for the consumer, variety is important in order for the taste preferences of the household to be accommodated as well as ensuring that the family enjoys their food.

Prevalent low micronutrient intakes and low energy intakes, as well as overconsumption of food with the associated increased risk for chronic diseases of lifestyle, are addressed.

There are, however, a number of potential problems which may arise from this guideline. The high levels of household food insecurity in South Africa will be a constraint on the implementation of this guideline. Increasing dietary variety could be interpreted as increasing the number of processed foods of low micronutrient and phytochemical content, particularly in the urban context. Obesity is a problem for some sections of the population in South Africa and increasing dietary diversity could lead to increased energy intakes and obesity. Therefore, formulation of appropriate food guides and other measures are important to address these problems and to ensure that increasing dietary variety leads to increased intakes of appropriate foods that are good sources of micronutrients. The challenge is to ensure that these goals are achieved within the context of high household food insecurity and increasing urbanisation.

There are several diet-related public health concerns in South Africa. Food-Based Dietary Guidelines (FBDGs) have been proposed to attempt to resolve many of these public health problems.¹ As outlined in the introductory paper¹ South Africa is a society in transition with a double burden of diseases related to both under- and overnutrition. Poorer populations have problems of stunting, micronutrient deficiencies and a greater risk of infectious disease, while both richer and poorer populations are more prone to obesity and chronic degenerative diseases.

'Enjoy a variety of foods' is the first of the ten FBDGs. This guideline attempts to focus on some of the consequences arising from a lack of dietary variety. Results of the 1999 National Food Consumption Survey in South Africa showed that the diets of many households, particularly lower income households, have low dietary variety.² The aim of this guideline is to encourage people to change their diets where necessary so as to increase the variety of foods eaten and to enjoy their food. The guideline needs to be understood in the context of the other FBDGs and to be applied with the assistance of a food guide.

The aim of this paper is to discuss the rationale and scientific background for the recommendation to enjoy a variety of foods. It should be noted that the FBDGs are for children aged 5 years and older and for all 'healthy' South African adults (excluding pregnant and lactating women).

CONCEPTUALISATION OF THE FBDG 'ENJOY A VARIETY OF FOODS'

Conceptualisation of dietary variety by nutritional scientists

Nutritional scientists are interested in quantifying and describing dietary variety because of possible relationships between dietary variety and the nutritional quality of the diet and between dietary variety and the health of people consuming the diet.

Dietary variety can be conceptualised and measured in a number of ways. The choice of index that is used to assess dietary variety is therefore important, since the use of different indices may lead to different conclusions regarding relationships with dietary variety. Two primary approaches have been used to create an index of dietary variety. The first is the calculation of a score based on the numbers of individual foods consumed. The second is to group foods into major and minor food groups, and derive a score based on the number of food groups consumed.³ A key issue in determining the dietary variety score is determining which foods should count as the same or different items.⁴

Nutritional scientists argue that it is useful to examine the diets that people consume in terms of a global index of the variety of foods eaten. Human diets are complex. In addition to

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Discipline Dietetics and Human Nutrition, University of Natal

E M W Maunder, BSc Nutr, PG Dip Diet, PhD

UNICEF, South Africa

J Matji, BSc Nutr, MSc Nutr

Institute for Human Nutrition, MEDUNSA

T Hlatshwayo-Molea, BSc Diet

examining individual nutrients and other food constituents, there are many nutrient-nutrient interactions. Therefore, it is difficult to draw conclusions regarding the effects of a single food or nutrient on health outcomes.⁵ Furthermore, our nutritional knowledge is incomplete, but expanding continuously, both in terms of nutrients and non-nutrients present in food that may impact on public health. Therefore, it is important to advocate the consumption of a variety of foods to ensure that there is a positive outcome on health, notwithstanding the limitations in our knowledge. In particular, it is important to ensure that the biodiversity of food sources is maintained and nutrient-dense foods are consumed.

Conceptualisation of dietary variety by South African consumers

Focus-group discussions with Xhosa, Zulu, Afrikaans and English consumers in the KwaZulu-Natal and Western Cape provinces of South Africa, among urban (formal and informal) and rural populations, showed that dietary variety was conceptualised as including different foods and different food groups as part of the diet.⁶ This was achieved both by varying the composition of foods used in each meal as well as varying the composition of meals from day to day. In addition, in households where there are few foods available, altering the method of food preparation was cited as a means of increasing dietary variety. All groups thought that the part of the guideline referring to variety was important in order for the taste preferences of the household to be accommodated, as well as ensuring that the family enjoyed their food and received the required nutrients.

These different interpretations of dietary variety can be viewed as complementary and as addressing differing specific public health problems.

The word 'enjoy' was understood as meaning to be satisfied or happy with and liking the food. It is interesting to note that in the situation of household food insecurity, focus-group participants talked about enjoying food in the sense of being lucky to have food. The focus-group participants also understood the term enjoy to refer to enjoying foods which fitted in with household taste preferences. In addition, it is interesting to note that household taste preferences could lead to the exclusion of certain foods.

Reflections on the conceptualisation of dietary variety by nutritional scientists and by South

S8 African consumers

It would, therefore, appear that there is much commonality between the conceptualisation of dietary variety by nutritional scientists and by South African consumers. In this regard, both nutritional scientists and consumers conceptualised dietary variety as including different foods and different food groups

as part of the diet, as well as altering the method of food preparation. Nevertheless, nutritional scientists try to define dietary variety more precisely and quantitatively in order to enable them to formulate and test hypothesis regarding the relationship of foods, dietary quality and disease, whereas the consumer had a greater emphasis on the taste and enjoyment of food, which provides a useful background to the formulation of appropriate nutrition education.

DIETARY DISORDERS OF PUBLIC HEALTH SIGNIFICANCE

A lack of dietary variety is thought to contribute to:

- low micronutrient intakes
- low energy intakes
- chronic diseases of lifestyle.

Low micronutrient intakes

Dietary diversification is one of the four main strategies advocated internationally for the improvement of micronutrient status in undernourished individuals.

A guideline on dietary variety has been substantiated in other countries on the basis of the need to consume more than 40 different essential nutrients. This is felt to be particularly important in relation to nutrients which are found only in a few foods such as vitamin A and its precursors, calcium, iron and vitamin C. When few such foods are consumed, intakes of these particular nutrients may be lacking.⁷

Data from the 1999 National Food Consumption Survey of children aged 1 - 9 years in South Africa,² showed that low income households had only a few foods present in the house, that few foods were consumed by the children and that low micronutrient intakes were widespread. The same survey showed that the average number of foods consumed in low income households nationally was 8 and varied from 4 in the Free State to 13 in the Western Cape, indicating a low dietary variety. The foods found most frequently in the household inventory of lower income households (< R12 000 per household per year) were maize, salt, white sugar, tea, fat/oils, white rice and white bread. These foods, together with brown bread and hard margarine, were the foods most frequently consumed by all children in the survey on the basis of the 24-hour recall (24 HR) method. All other foods listed (24 HR) such as chicken, beef, cabbage and squash, were consumed by less than a third of the sample, which is important in relation to the low micronutrient intakes reported in the survey. Therefore, there is a need for an increased intake of a variety of foods, e.g. fruits, vegetables, meat and legumes which will also contribute to improving micronutrient status.

Food consumption data from North America have shown that variety in food choices and dietary quality are related.⁸ Simply including foods from each of the five major food

groups used in the USA (i.e. milk and milk products, grain products, fruits, vegetables, meat and meat alternatives) showed a correlation with the nutritional adequacy, measured as the mean adequacy ratio (MAR), an index of the percentage of recommended intake for eleven nutrients: protein, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, and vitamins B₆, B₁₂ and C. The authors suggest that the simplest approach to interpreting 'Enjoy a variety of foods' may be to include foods from each of the five food groups. The data also indicate that the addition of only one extra food item to a diet of poor dietary variety led to a significant increase in MAR, which was not the case when dietary variety was initially high.

A similar analysis of the South African National Food Consumption Survey data still needs to be done. However, given the low number of food items consumed in the diet from the different food groups, and the low reported micronutrient intakes, one can safely state that an increase in the variety of food from these food groups will be associated with improved micronutrient intakes in South Africa.

This important consideration should be borne in mind in view of the consumer's interpretation of increasing dietary variety by altering methods of food preparation. The latter will not improve the micronutrient intake of the diet where the diet consists of a few foods/few food groups and has a low micronutrient content.

Low energy intakes

The National Food Consumption Survey² showed that there were widespread low energy intakes in children aged 1 - 9 years. The number of foods consumed by these children was also low.² Low energy intakes in developing countries have been ascribed to the lack of available food, and also type of foods available, e.g. the low fat content of many African diets.⁹

Low energy intakes could be increased by increasing the variety of foods eaten. Golden¹³ has suggested that nutrients can be divided into types I and II and that deficient intakes of type II nutrients, e.g. zinc, are associated with anorexia. It can be postulated that a vicious cycle is set up when low dietary variety is associated with reduced energy and micronutrient intakes and a depression of appetite, further exacerbating the low energy intakes. Underwood¹⁰ postulated that part of the cause of low energy intakes in developing countries is related to the monotony of the diet. This hypothesis was tested in a clinical study in Peru and the results cited by Brown *et al.*¹¹ show that in children fed two diets with a similar nutrient composition the energy intake was increased by 10% when the taste, colour and consistency of the diet was varied. This finding is in line with views expressed by the focus-group studies on consumers in South Africa, that altering the method of food preparation can also be used as a means of increasing dietary variety.⁶

Furthermore, two studies in adults, one in France⁴ and one in the USA,¹² have shown an association between increased dietary variety and increased energy intake. The former study used a dietary diversity score based on the number of food groups consumed, while the second study used an index based on the number of different food items consumed within food groups.

Chronic degenerative diseases

South Africa faces overnutrition-related chronic diseases of lifestyle such as hypertension, cardiovascular disease, non-insulin-dependent diabetes mellitus and cancer, which are prevalent in all population groups.

The observed relationships between diet and chronic diseases of lifestyle have been investigated. Many studies have shown that diets high in fruits and vegetables and low in meats and fats are protective against the development of chronic diseases of lifestyle. It is most unfortunate, however, that although the relationship shown is based on the consumption of specific foods, both scientists and public health professionals tend to trivialise the importance of wholesome foods by concentrating on the individual components of the diet and their chemical nature.¹⁴ In terms of nutrition of the public and also in terms of scientific understanding, working with foods rather than any one of their components has much to be recommended. In this regard Wahlqvist and Specht¹⁵ have shown that the food pattern most protective against disease is one of food diversity, which is defined as using probably 20 - 30 biologically distinct foods in a week.

Several investigators have studied the relationship between dietary diversity (measured as an index based on food or food groups) and disease outcome³ and many but not all have found an inverse relationship between increased dietary diversity and mortality (all cause), cancer and cardiovascular disease.

A recent analysis by Kant *et al.*⁵ found an inverse correlation between the Recommended Food Score and all cause mortality in American adults. The Recommended Food Score is the score derived by comparing the number of foods reported to be eaten at least once a week with those recommended by current dietary guidelines, i.e. fruits, vegetables, whole grains, low fat dairy products and lean meats and poultry. The conceptual framework for the food score is therefore broader than using a dietary variety score which only counts the number of foods, as suggested by Drewnowski *et al.*⁴

It would seem that in relation to the prevention of chronic diseases of lifestyle, particularly in relation to obesity (see below), this guideline must, as is intended, be used in conjunction with the other FBDGs to ensure that there is sufficient intake of foods containing protective factors and a reduced intake of foods which are known to increase the risk of disease.

POTENTIAL PROBLEMS ARISING FROM THE GUIDELINE 'ENJOY A VARIETY OF FOODS'

The FBDG work group recognises that there may be a number of problems which arise in implementing this guideline, namely:

- The high levels of household food insecurity in South Africa.
- The recommendation of increasing dietary variety could be misinterpreted as increasing the number of processed foods, which in the urban context at least, could lead to an increase in the consumption of processed foods of poor micronutrient and phytochemical content.
- Increasing dietary diversity could lead to an increased dietary energy intake, thereby exacerbating the increasing prevalence of obesity in certain sections of the South African population.

Household food insecurity and other barriers

On the basis of the available evidence there can be little doubt that it would be desirable to increase dietary variety of South African diets, particularly of people living in low income households. However, achieving this goal will be most difficult for this section of the population because of the constraints of poverty. There is ample evidence of household food insecurity in South Africa when either indirect or direct indicators are used to measure it. May,¹⁰ using indirect economic indicators, has shown high levels of food insecurity, a finding confirmed by direct measurement of food present in low income households by the National Food Consumption Survey.²

The focus-group studies in KwaZulu-Natal and the Western Cape also identified affordability as a major constraint, particularly with regard to fruits, vegetables and foods of animal origin.⁶ Other problems were time constraints and routine food-purchasing habits.⁶

Because the high levels of food insecurity in South Africa will make it difficult for people to apply this guideline, the implementation of the Poverty Alleviation Programme and promotion of income generation are important prerequisites to its success. In addition a nutrition education campaign is needed for all the guidelines, including this specific one. This campaign should be sensitive to financial and other constraints, be multisectoral and aim at targeting specific population groups at different levels of socio-economic status.

Consumption of processed foods

S10 Particularly in the urban context with an abundance of processed foods, increasing dietary variety could be misinterpreted as increasing the consumption of processed foods. This could be counterproductive in terms of the aim of this recommendation, particularly in relation to increasing micronutrient intake and changing the proportions of macronutrient intakes to reduce the risk of chronic degenerative diseases.

As stated by Gussow and Clancy,¹⁷ 'The proliferating 'variety' in the supermarkets does not reflect an equivalent biological variety ... Thus nutritionists must help consumers learn to create a demand for a wider variety of whole foods instead of a succession of food novelties whose claim to diversity is based on processing techniques and artificial colors and flavors.' This is particularly true in view of the findings of Bourne,¹⁸ which have shown that with migration to urban areas in South Africa, increased urban exposure was associated with an increased atherogenicity of the diet of African adults, namely an increase in the proportion of energy supplied by fat and a decrease in the proportion of energy supplied by carbohydrate. In terms of foods this was related to a decreased consumption of dairy foods and cereals and an increased consumption of meat, and also of non-basic foods or nutrient-empty foods, such as potato crisps and carbonated drinks. Of further particular interest to the issue of dietary variety is the finding of Bourne *et al.*¹⁹ that the urban diet was confined to a relatively narrow range of foods, with low intakes of dairy products and fruits and vegetables. A later survey involving all population groups also showed that intakes of dairy products and fruits and vegetables are low, particularly in Asians, coloureds and Africans.²⁰

The meaning of the guideline should therefore be discussed using appropriate food examples.

Increase in obesity

The prevalence of obesity is high among some sections of the population in South Africa. Increasing dietary diversity could potentially lead to an increased energy intake and therefore contribute to a further increase in the prevalence of obesity and associated problems such as diabetes mellitus and cardiovascular disease.

Studies investigating the effect of increasing the variety of foods at a meal showed that more food is eaten when dietary variety is high than if the selection of food is limited.²¹ Data on sensory-specific satiety by Rolls and McDermott,²² suggest that increasing dietary variety in a manner which leads to different sensory properties of food does lead to increased energy intake. While this is desirable in certain situations, e.g. where the energy intake is lower than requirements, it is not desirable when it leads to the development of obesity. Rolls²¹ warned that advice to eat a variety of foods might lead to overconsumption of energy. Food consumption data of a large and varied group of adults in the USA indicate that increased variety within food groups was also associated with increased body fatness and increased energy intakes. Further analysis of the data however also showed that this varied within food groups, e.g. increased variety within the vegetable group was negatively associated with percentage body fat whereas increased variety within the combined group of sweets, snacks and condiments was positively associated with the percentage of body fat.¹² McCorry *et al.*¹² concluded that a high variety of sweets, snacks,

condiments, entrees, and carbohydrates, coupled with a low variety of vegetables, promotes long-term increases in energy intake and body fatness. In terms of consumer understanding, therefore, in the USA the Dietary Guideline on variety was misinterpreted as a licence to consume foods that may not be considered healthy choices, a scenario to be avoided at all costs in South Africa.²³

The US experience therefore raises three issues to be addressed in nutrition education of the South African consumer: firstly, the importance of limiting dietary variety within certain food groups where energy intake is adequate and emphasising the importance of fruit and vegetable consumption; secondly, the importance of including information about portion sizes; and thirdly, the importance of the guideline on physical activity.

RATIONALE FOR THE USE OF THE TERM 'ENJOY'

Guidance given on the implementation and use of FBDGs by the FAO/WHO consultation²⁴ included the concept that guidelines should be user-friendly and positive without negative prescriptive clauses. Therefore, in formulating the first guideline the term 'enjoy' has been chosen. The working group is of the opinion that a recommendation to enjoy eating will encourage families to share meals, to use meal times to interact, relax and cope with stress — all measures to promote health and prevent the risk of disease. The term 'enjoy' is included in an attempt to ensure this. However, its effectiveness in this regard has not been tested in South Africa.

CONCLUSION

The responses obtained from the focus groups of consumers as well as the thinking of nutrition scientists internationally are in line with the thinking of the Working Group in drawing up the guidelines.

While work on dietary variety is ongoing there is scientific evidence to support the inclusion of the use of the FBDG 'Enjoy a variety of foods', particularly with regard to increasing micronutrient and energy intakes and protection against the development of chronic diseases of lifestyle. However, careful thought should be given to the formulation of appropriate food guides and other measures so that increasing dietary variety does lead to increased intakes of foods from food groups which are currently infrequently consumed by many South Africans. This is important to ensure that micronutrient and energy intakes increase where appropriate, and at the same time to prevent increased energy intake and obesity in those individuals who already have an adequate energy intake. The challenge which faces South African nutritional professionals is to ensure that these goals are achieved within the context of high household food insecurity and increasing urbanisation.

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'BE ACTIVE' — PHYSICAL ACTIVITY FOR HEALTH IN SOUTH AFRICA

E V Lambert, I Bohlmann, T Kolbe-Alexander

The Food-Based Dietary Guideline 'Be active' provides a general and widely understood message that regular physical activity is 'health promoting'. When considered in the South African context, where chronic disease and risk factor prevalences are relatively high and physical activity participation is unexpectedly low, this guideline is not only appropriate, but once implemented, may impact significantly on the overall population attributable risk due to an inactive or sedentary lifestyle. Successful implementation of the guideline depends, in part, on interpreting the effective dose-response, associated with specific morbidity outcomes. Expert consensus recommends that individuals accumulate 30 minutes of moderate to vigorous activity on most days. This amount of exercise is associated with a more than 1.5 - 2-fold reduction in, for example, cardiovascular disease mortality. This document addresses the potential barriers to widespread adoption of physical activity at a community level, and individual barriers to participation. Furthermore, we review a theoretical framework known as the 'stages of change' model, to contextualise the stages that individuals undergo when adopting some lifestyle change, such as physical activity.

The Food-Based Dietary Guidelines (FBDGs) have been developed with the aim of making evidence-based nutrition and lifestyle messages to the public accessible, understandable, generalisable, acceptable in a cross-cultural context, and feasible. Furthermore, these messages are formulated to be positive rather than punitive or negative. One of the more important and widely understood messages is encouragement to participate in regular, lifestyle physical activity. The guideline 'Be active' is based on the now well-established link between physical activity and lowered risk of all-cause mortality, as well as mortality and morbidity associated with many chronic diseases of lifestyle. The American College of Sports Medicine (ACSM) and the United States Centers for

Disease Control (CDC) now recommend that individuals should attempt 'to accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week'.¹ The salient part of these ACSM/CDC recommendations is the concept 'to accumulate', which indicates that the exercise dose may consist of physical activity 'taken' in smaller units of time; yet a similar health risk reduction may be expected.² In addition, this message is compatible with an increasing focus on lifestyle or habitual physical activity, structured around household and gardening activities, transport and leisure-time.

The guideline 'Be active' is important, firstly, because there is a substantial and increasing burden of chronic disease in the South African population. Secondly, there is evidence that although South Africa is a 'sporting nation', reported levels of physical activity in urban populations are comparable with those of more developed countries. The focus of this document is: (i) to examine the burden of chronic disease and associated risk factors in the 'target' population; (ii) to provide the evidence base for the efficacy and effectiveness of physical activity in changing this disease burden; and (iii) to highlight the challenges and opportunities for implementing this guideline at individual, group, and population-based levels.

THE BURDEN OF CHRONIC DISEASES OF LIFESTYLE IN SOUTH AFRICA

South Africa is a country of many contrasts, in which various communities are undergoing rapid epidemiological, nutritional and demographic transition.^{3,4} As a consequence of this transition, chronic diseases of lifestyle coexist with communicable diseases associated with undernutrition and lower socio-economic conditions. Recent studies suggest that chronic diseases of lifestyle accounted for 28.5% of deaths of all South Africans between the ages of 35 and 64 years and that more than 56% of all South Africans between the ages of 15 and 64 years have at least one modifiable risk factor for chronic diseases of lifestyle.⁵ In the recent National Demographic and Health Survey (DHS) conducted in 1998, the prevalences of risk factors such as hypertension and obesity, were comparable with figures for developed countries (Table I).⁶⁻¹³

There are few national data available on the prevalence of physical inactivity, particularly in communities undergoing demographic transition. However, in two cross-sectional studies of urban black South Africans living in the Western Cape, between 30% and 40% of men and women reported no physical activity in either occupation or leisure time, and a further 40 - 60% reported minimal-to-moderate activity.⁶⁻¹³ Furthermore, in a recent cross-sectional study of a peri-urban community in the Western Cape, physical inactivity was associated with increased diabetes prevalence, and had a relative risk of 1.72 (95% CI: 1.06; 2.81, $P < 0.03$).¹⁴ 'Vulnerable groups' reporting the lowest levels of activity in this study

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MRC/UCT Research Unit for Exercise Science and Sports Medicine, Sports Science Institute of South Africa, University of Cape Town

E V Lambert, PhD

I Bohlmann, BSc Hons

T Kolbe-Alexander, BSc (Med) Hons

Table I. Prevalence (%) of chronic diseases of lifestyle risk factors in adult South Africans (age-adjusted against a world population, using high-risk cut-off points¹³ and unpublished data from the DHS)*

	Hypertension	High serum cholesterol	Type 2 diabetes	Obesity	Smoking (cigarettes regularly)
Cut-off point	BP > 160/ 95	> 6.5 mmol/l	WHO criteria	> 30 BMI	Daily or weekly
Age group	≥ 15 yrs	15 - 64 yrs	30 - 65 yrs	≥ 15 yrs	≥ 15 yrs
Men					
Black	12.9	1.1	8.0	9.0	33.9
Coloured	14.9	17.4	10.8	9.7	54.9
Indian	18.7	20.2	13.0	8.6	47.7
White	20.6	25.6	2.2	19.8	33.4
Total men	14.1	6.2	8.0	10.1	36.2
Women					
Black	15.7	2.3	8.0	29.0	5.0
Coloured	22.7	16.2	10.8	25.3	40.6
Indian	20.5	17.0	13.0	21.0	9.0
White	18.5	26.0	2.8	26.3	26.6
Total women	16.1	9.0	8.0	27.9	11.1
Total South Africans	15.7	7.8	8.0	19.2	22.9

BMI = body mass index.

*These data were compiled for draft Guidelines for the Prevention and Management of Overweight and Obesity by KS Steyn.

include: young women (15 - 24 years), as well as men and women over the age of 55 years. More recently, a survey conducted on transitional African communities in the North-west Province of South Africa (THUSAstudy, Transition and Health during Urbanisation of South Africans) by Kruger *et al.*¹⁵ demonstrated that inactivity, independently of the degree of urbanisation, was associated with increasing obesity levels ($P = 0.0007$). These data provide the basis for the rationale underpinning the 'Be active' guideline.

EVIDENCE BASE ON WHICH GUIDELINE 'BE ACTIVE' HAS BEEN FORMULATED

As previously mentioned, physical inactivity is now recognised as a major risk factor for the non-communicable diseases (NCD) such as: hypertension, cardiovascular disease, diabetes and cancer. Current recommendations for participation in physical activity are based on the ACSM/CDC guidelines, 'to accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week'.¹ The basis of the recommendation for regular physical activity is that there is a plausible biological argument for an effect. Physical activity appears to be 'protective' for chronic diseases, acutely lowering serum triglyceride concentrations, improving tissue sensitivity to insulin, increasing fibrinolytic activity, decreasing clotting activity, increasing high-density lipoprotein (HDL) cholesterol concentrations and lowering blood pressure.¹³ Furthermore, in many instances physical activity increases bone mineral density, and helps to maintain a healthy body weight. In the longer term, physical activity has been shown to lower the overall risk of all-cause mortality in men between the ages of 45 and 84 by 18%.

The effects of physical activity on risk for chronic disease can also be observed in a dose-dependent manner. In many studies, the benefits of exercise are greater with increasing frequency, duration or intensity. However, the dose-response is not linear. There are greater health benefits in changing from a completely sedentary lifestyle to becoming moderately active than in the change from moderate to very active exercise.¹⁶

Lee *et al.*,¹⁷⁻¹⁹ using the Harvard alumni cohort of more than 17 000 original subjects, compared the potential benefits of both vigorous and non-vigorous exercise for lowering the risk of all-cause mortality, during a period of follow-up lasting, in some cases, up to 30 years. (After adjustments were made for smoking, obesity and other potential confounders, vigorous physical activity levels were found to be 'protective', whereas non-vigorous activity was not significantly or inversely associated with mortality rate.

Lee and colleagues¹⁹ also compared the relative risk associated with continuous exercise, lasting for at least 30 minutes, or activity broken up into smaller 15-minute periods. They found that there was a significant inverse relationship between the average duration of exercise sessions and coronary heart disease risk during 5 years of follow-up. However, the effect of duration was no longer significant if adjusted for total energy expenditure. Thus, the total energy expenditure, and not the duration of each physical activity episode, predicted risk benefit, and partially corroborates these ACSM/CDC recommendations.

Moreover, research suggests that the broader guideline of 'accumulating 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week' is more widely accepted, and individuals are more adherent, than

when following the traditional guidelines of 20 - 60 minutes of vigorous activity at least 3 times per week. Weyer *et al.*²⁰ found that overweight women following the ACSM/CDC guidelines for a period of 16 weeks lost more weight, and were twice as compliant as a control group, or a group following the more rigid, traditional guidelines.

The intensity, frequency and/or duration of exercise that may be regarded as protective for morbidity and mortality will also vary depending on the purpose for which the activity is undertaken, the disease outcome under consideration, baseline levels of physical activity, age, gender and other possible confounders, such as smoking, and family history of disease.

EXPECTED HEALTH BENEFITS OF EFFECTIVE IMPLEMENTATION OF 'BE ACTIVE' GUIDELINE

The expected health benefits of regular participation in physical activity have been extensively reviewed.^{1,21} There is now substantial evidence that regular physical activity is associated with a lowered risk for chronic disease of lifestyle. The strength of this evidence is that it is both consistent (demonstrated in many different studies over time) and robust, demonstrated in a variety of different populations and age groups, to similar effect.²²

We can interpret the potential health benefits of widespread adoption of physical activity by considering both the relative risk and the population attributable risk associated with sedentary living. The relative risk provides an indication of the comparative risk for chronic disease in the sedentary v. exercising population (as a ratio) but provides no insight into the magnitude of the effect. The population attributable risk (PAR %), on the other hand, represents the number or proportion of cases of disease that may theoretically have been prevented if those individuals who were sedentary had been regularly physically active.

Colditz²¹ recently reviewed the burden of disease associated with inactivity, including chronic diseases, such as coronary disease, hypertension, cancer, gall bladder disease and osteoporosis (Table II). Sedentary living is associated with a

1.2 - 2-fold higher relative risk of these chronic conditions. If we assume that approximately 29% of the USA population report no leisure time physical activity, the population attributable risk or the percentage of cases associated with inactivity ranges from 5% for breast cancer to 22% for coronary heart disease. Farrell *et al.*²³ considered the impact of low fitness levels as a 'proxy' for low levels of habitual physical activity, on cardiovascular disease mortality, in relation to other known risk factors such as smoking, obesity, hypertension, hypercholesterolaemia, and elevated blood glucose concentrations. The relative risk for cardiovascular disease mortality was 1.7 (95% CI: 1.3 - 2.3) for low fitness levels and was comparable with, if not higher than, the relative risk for smoking, hypertension, etc.

However, to form a more realistic basis of comparison, one would need to compare the prevalence of the risk factor (smoking v. inactivity) in a community, and the extent to which the risk factor was modifiable. In addition, one would have to consider the possible effect of attrition or relapse. In general, the relapse rate for physical activity may be lower than that for smoking cessation and weight loss, and in many communities, the prevalence of inactivity is higher than that of smoking. This makes physical activity an ideal target for public health intervention.

PRACTICAL IMPLEMENTATION OF 'BE ACTIVE' GUIDELINE IN SOUTH AFRICA — CHALLENGES AND OPPORTUNITIES

The successful implementation of the 'Be active' guideline is dependent, in part, on identifying and addressing barriers to physical activity participation in the population, in general and on an individual basis. Sparling *et al.*²⁴ suggest that an 'ecological perspective' be adopted, to consider the interaction between individual characteristics, which are both psychological and biological, and environmental factors, which include societal norms and physical activity, in order to better understand and formulate targeted, population-based interventions. Pate *et al.*¹ and King *et al.*²⁵ summarised individual barriers to physical activity. These barriers may be demographic, e.g. age and gender are associated with physical activity participation. Women and older persons are less likely to participate in vigorous, leisure-time physical activity.^{25,26} Further, socio-economic status and education are usually inversely related to leisure-time physical activity levels. Alternatively, certain negative health behaviours, such as obesity and smoking, are associated with sedentary living and reduced participation in physical activity. Thus, 'the adoption of regular exercise is linked, in some groups, to the knowledge of, and belief in, the health benefits of physical activity'.³

From an implementation perspective, perceived lack of time is one of the most common reasons given for low levels of exercise participation.^{25,26} In a random survey of 320 working

Table II. Relative risk and population attributable risk (PAR %) for inactivity for various chronic diseases*

Condition	Relative risk	PAR %
Type 2 diabetes	1.5	12%
CHD	2	22%
Hypertension	1.5	12%
Gall bladder disease	2	22%
Cancer		
Breast	1.2	5%
Colon	2	22%
Osteoporotic fractures	2	18%

*Modified from Colditz.²¹

adults in urban Lagos, Nigeria,²⁷ the most commonly cited barriers to participation in physical activity were work commitments (31%) and lack of time as a result of commuting (26%). At an environmental level, Bauman *et al.*²⁸ recently described the 'coastal effect'. Adult Australians living in close proximity to coastal regions were 27% more likely to report levels of physical activity compatible with reduced risk for chronic diseases of lifestyle than those living inland. These studies highlight the importance of considering environment and accessibility as determinants of physical activity when formulating public health policy using physical activity as a vehicle for health promotion.²⁹

On an individual level, self-efficacy is recognised as the strongest determinant of adoption of a physically active lifestyle.³⁰ Self-efficacy may be defined as 'one's confidence in one's ability to exercise or to become physically active'.³ Self-efficacy may be influenced, both positively and negatively, by prior experiences and through the experience and verbal support of family or friends, or by a change in physiological status, as well as the perception of health and well-being.³⁰ Thus, family participation and social support are also important determinants of physical activity behaviour.²⁹

There is now evidence to support an existing theoretical framework as to how individuals adopt exercise behaviour. The transtheoretical or 'stages of change' model is an integrated model which incorporates the individual's intention to change his/her lifestyle, along with his/her expressed 'readiness' for change. This model involves techniques such as: raising awareness of the health benefits of physical activity, re-evaluating one's self and one's environment, creating support networks, and developing a system of reinforcement, and self-management. Central to this model, as with the others, is the concept of self-efficacy.^{29,31}

The five stages of change include:

- pre-contemplation (individuals who are sedentary and have no intention to change, have no knowledge of the problem, or are in denial of any need to change)
- contemplation (individuals who have expressed an intention or desire to change or to become more physically active)
- preparation (individuals who have managed to make or incorporate small changes in physical activity behaviour)
- action (individuals who have become regularly physically active)
- maintenance (individuals who are engaging in regular activity or in whom regular activity has become established).

Recent studies suggest that 'readiness' for change is a significant determinant of adoption of a physically active lifestyle or the likelihood of achieving the action/maintenance stages of exercise. Steptoe *et al.*³² studied the impact of lifestyle

behavioural counselling in more than 880 patients attending 20 primary health care centres in the UK. The odds ratio of moving to the action/maintenance stages for physical activity for those who had received counselling was 1.89 (95% CI: 1.07 - 3.36) compared with the control groups. These and other data suggest that the primary care setting may be opportune for providing targeted support for persons who may be contemplating changes in physical activity. However, Podl *et al.*³³ found that less than 25% of family physicians surveyed in Ohio ($N = 138$; 4 215 visits) spent time counselling about exercise. Of those who did counsel on exercise, the mean time spent in consultation was 0.78 minutes (ranging from 0.33 to 6.00 minutes). Doctors who were themselves physically active were more likely to raise the topic of physical activity for health with their patients.³⁴ Thus, in devising public health initiatives around physical activity, it may be important to focus on educating and motivating the health care providers.

In real terms, the co-ordination of physical activity initiatives for health promotion in South Africa has been fragmented, with little emphasis on sustainability. There is a lack of basic infrastructure and facilities in many communities; physical education within the public school system is under threat, particularly in historically disadvantaged communities; there is a high prevalence of urban violence and risk to personal safety; and the current focus for government health expenditure is on the delivery of primary health care.³²⁴ As such, the majority of South Africans studied in various regional cross-sectional surveys report low-to-moderate levels of participation in physical activity, and fail to meet the ACSM/CDC recommendations of '30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week'.

Lower barriers and increasing participation — community development models

The development of successful, community-based physical activity interventions in communities undergoing transition relates in part to overcoming cultural, socio-demographic, physical and financial barriers to participation. Effectiveness data are available for only a relatively small number of community-based interventions for lifestyle and physical activity, in transitional communities. One example of such a programme is PATHWAYS, a church-based programme for weight loss designed for African-American women. PATHWAYS relied on volunteer lay leadership, and as a church-based programme, already lowered some of the barriers to participation. Physical activity was promoted via home-based walking and recreational activity. Women randomised into active groups lost more weight, and reported physical activity levels increased significantly, compared with the controls (who were recruited but placed on a waiting list).

One example of a regional initiative aimed at increasing

broad-based participation in physical activity in South Africa is the Community Health Intervention Programmes (CHIPs), a joint venture between a privately funded, non-profit academic institution and a national insurance company. The CHIPs project exists to promote health through the medium of regular physical activity. The project has several programmes, targeting and responding to the needs of, for example, older adults from community centres or a school-based programme for primary school children, both of which have been shown to be highly sustainable, and have had a measurable impact on health status and fitness.

'The programmes employ a two-fold strategy: education to increase awareness regarding the risk for developing chronic diseases of lifestyle, and regular physical activity to encourage adherence and self-efficacy in making healthier lifestyle choices. The programmes are run at central venues in the community, reducing barriers to participation such as distance and cost.³ This is achieved by using a participatory approach for community development, incorporating a consultation phase and a training phase for peer-group leaders, followed by a phase of co-implementation of programmes. Co-implementation takes place for 3 months, after which time the programme staff withdraw and ownership of programmes is transferred to the community. Community participants become owners of the project upon completion of a training and capacity-building process, thus helping to secure sustainability.

DISCUSSION AND CONCLUDING REMARKS

In this review, we have highlighted the evidence-based argument for the role of physically active lifestyles in promoting health and lowering the burden of chronic diseases of lifestyle. Although the guideline 'Be active' specifically targets adults, regular physical activity is equally beneficial for older adults. Moreover, the lifestyle patterns that support the development of chronic disease are established in childhood. Therefore, the guideline may be extended and is appropriate for school-going children. Perhaps the most important concern is the successful and widespread adoption of this guideline, which can be facilitated by identifying and addressing barriers within communities, and by characterising 'readiness to change' in individuals. Primary health care practitioners, community leaders, and parents will have a significant role to play in creating an awareness of 'how much exercise is enough' to prevent or attenuate chronic diseases of lifestyle.

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MAKE STARCHY FOODS THE BASIS OF MOST MEALS

H H Vorster, T ANell

The scientific evidence for the guideline, 'make starchy foods the basis of most meals' is reviewed. Worldwide, but especially in developing countries, starchy or high-carbohydrate foods such as cereals, grains and some root vegetables, are the main sources of dietary energy and valuable sources of micronutrients and dietary fibre when they are eaten in minimally processed forms. These foods also contribute protein to the diet.

Recent research has shown that foods rich in carbohydrates in the form of starch, resistant starch, sugars and non-starch polysaccharides or dietary fibre, influence health and prevent chronic diseases by various effects and mechanisms. These include direct effects on digestion, absorption, fermentation and metabolism; indirect effects by providing micronutrients and phytochemicals; and replacement effects, mainly of fat and animal protein.

There is convincing evidence that through these mechanisms high-carbohydrate diets lower risk of several chronic diseases such as obesity, non-insulin-dependent diabetes mellitus, cardiovascular disease, cancer and other gastro-intestinal diseases. Available data indicate that especially white, coloured and Indian South Africans could benefit by increasing intakes of cereals and grains, and that all South Africans should eat more of their cereals and grains in an unprocessed or minimally processed form. The pending fortification of maize meal and bread flour with micronutrients should increase the contribution of starchy foods to micronutrient intakes. It is concluded that available evidence supports this guideline. The guideline is furthermore practical, culturally sensitive, affordable, and sustainable.

The guideline, 'make starchy foods the basis of most meals', is aimed at 'optimum' intakes of cereals and grains such as maize, wheat, sorghum, oats and rice in the form of porridges, breads, pastas, rice, samp, maize rice, breakfast cereals and other products. The guideline advises that in planning of meals, the starchy food should be the central or main food, and the rest of the meal planned around this food. The underlying nutritional objective is to promote an increased intake of

School of Physiology, Nutrition and Consumer Sciences, Potchefstroom University for Christian Higher Education, Potchefstroom, North West

H H Vorster, MSc, DSc

T ANell, MSc, PhD

carbohydrate-rich foods in those people who have low intakes, and to maintain optimal intakes among those currently eating high-carbohydrate diets. Other carbohydrate-containing foods are root crops, sugar crops, pulses (legumes), vegetables, fruit and milk products. The recommendation to make starchy foods the basis of most meals should be accompanied by advice to choose unrefined or minimally processed cereals and grains where possible, and to concentrate on fortified cereals and grains when available.

There are several ways in which high intakes of cereals and grains will beneficially influence total nutrient balance and health. Direct effects of an increased starch intake on the physiology of the intestinal tract and metabolism can be expected. Many associated substances in these foods such as cereal fibre, oligosaccharides, phytoestrogens, phytosterols, flavonoids, terpenes and isothiocyanates are now known to influence health beneficially. Carbohydrate-containing foods are also excellent sources of several vitamins and minerals, and some, if eaten in sufficient quantities, can make substantial contributions to protein intake. Although some of the substances such as phytates in unrefined cereals and grains may inhibit absorption of these micronutrients, unrefined cereals and grains are accepted as good sources of micronutrients.

Increased intakes of starchy foods can also replace some animal-derived and fatty foods in the diet, leading to a decreased fat and animal protein intake. This, together with increased intakes of fibre, resistant starch and associated plant substances will decrease the risk of many overnutrition-related chronic diseases such as coronary heart disease (CHD), stroke, non-insulin-dependent diabetes mellitus (NIDDM), and some forms of cancer. The contribution of micronutrients to the diet by unrefined and fortified cereals and grains will help to prevent micronutrient undernutrition. Starchy foods therefore have direct, indirect or 'replacement' effects on nutritional status and health.

The scientific evidence to support these statements on the beneficial effects of starchy foods and/or high-carbohydrate diets, which form the background and motivation for this guideline, will be reviewed briefly.

DIETARY CARBOHYDRATES

The role of carbohydrates in human nutrition, maintenance of health and prevention of disease, has recently been updated and reviewed by a joint Food and Agricultural Organisation/World Health Organisation (FAO/WHO) Expert Consultation.¹ This consultation group defined carbohydrates as the polyhydroxy aldehydes, ketones, alcohols, acids, their simple derivatives and their polymers, with linkages of the acetal type.

A simplified classification of dietary carbohydrates is given in Table I, indicating that in addition to the amylose and

Table I. Simplified classification of dietary carbohydrates*

Class	Sub-group	Components	Remarks
Sugars 1 - 2 units polymerised †	Monosaccharides	Glucose, galactose, fructose Sucrose, lactose, trehalose	The term 'sugars' describes mono- and disaccharides; sugar is synonymous with sucrose; 'milk sugar' is lactose
	Disaccharides	Sorbitol, mannitol	
	Polyols		
Oligosaccharides 3 - 9 units polymerised	Malto-oligosaccharides	Maltodextrins	Some oligosaccharides are not digested to glucose and other monosaccharides, and could be classified on a physiological basis as dietary fibre or 'unavailable' carbohydrate
	Other oligosaccharides	Raffinose, stachyose, fructo-oligosaccharides	
Polysaccharides > 9 units polymerised	Starch (α -glucans)	Amylose, amylopectin, modified starches; rapidly digestible starch; resistant starch ‡	The amylose/amylopectin ratio in starch can be modified by plant breeding; starch can also be physically or chemically modified to change viscosity, mouth feel, appearance, texture, etc. as in many convenience products Group of carbohydrate substances not digested to glucose but fermented in large gut
	Non-starch polysaccharides (also known as dietary fibre)	Cellulose, hemicellulose, pectins, beta-glucans, gums, mucilages, hydrocolloids	

* Adapted from the Joint FAO/WHO Expert Consultation.¹

† Unit refers to the basic monosaccharide (usually a 6 carbon molecule) and polymerised to the connection of the monosaccharide units by glycoside bonds.

‡ Resistant starch refers to the fraction of starch that resists digestion in the small intestine but which is fermented in the colon.

amylopectin fractions of starch, modified starches and different degrees or types of resistant starch are now recognised as important dietary carbohydrates. Carbohydrates are the most important source of food energy in the world, providing 40 - 80% of total food energy intake, influenced by geographical location, cultural considerations and economic status.¹ In addition to being the main provider of dietary energy, carbohydrates function as sweeteners, making diets more palatable, and influence satiety mechanisms in the control of food intake. The dietary fibre components moderate digestion and absorption of other nutrients in the small bowel and together with undigested starch, form the major substrate for microbial fermentation in the large bowel, influencing bowel habits, metabolism and health.¹

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The nutrient goals for dietary carbohydrate intake¹ are based on three accepted scientific principles: (i) the minimum amount of carbohydrate needed in the human diet by adults to prevent ketosis is 50 g/day; (ii) at least 55% of total energy should be provided by a variety of carbohydrate sources to protect against chronic diseases (leaving a maximum of about 30% for fat and 15% for protein) — if more than 75% of dietary energy is provided by carbohydrate, intakes of fat, protein and some

micronutrients will be compromised; and (iii) moderate intake of sugar and sugar-rich foods can also provide for a palatable and nutritious diet.

Functions of dietary carbohydrate

As a group and also individually, the different dietary carbohydrates have a wide range of physiological effects that are important for maintenance of health and prevention of disease. These effects have been reviewed by the FAO/WHO Consultation,¹ and are summarised in Table II. They represent the direct effects of carbohydrates. As mentioned, carbohydrate-containing foods also provide other nutrients and phytochemicals (indirect effects) and will influence health and prevent disease by replacing fat in the diet. Therefore, a wide range and variety of carbohydrate-containing foods should be consumed to ensure adequate intake of these other substances.

Carbohydrate intakes of South Africans

The mean daily carbohydrate intakes of adult South Africans aged 25 - 65 years are summarised in Table III. Although there are gaps in available data, notably on habitual intakes of

Table II. Summary of physiological effects of dietary carbohydrate*

	Effect	Remarks
1.	Provision of energy	Starch digested to glucose and disaccharides has an energy value of 17 kJ/g; glucose has 15.7 g/kJ and undigested but fermentable CHO (starch and fibre) an estimated mean of 8 kJ/g.
2.	Satiety and gastric emptying	CHO suspected to have a positive role but more research, also on satiety index, is needed.
3.	Glucose and insulin homeostasis	The rates of digestion and absorption of dietary CHO influence blood glucose, insulin secretion and cellular glucose uptake. CHO intakes influence insulin sensitivity/resistance.
4.	Protein glycosylation	Non-enzymatic glycosylation of proteins is influenced by blood concentration of glucose and fructose and the half-life of protein. Low glycaemic index CHOs have smaller effects.
5.	Serum lipids and bile acids	High CHO diets which are also high in soluble dietary fibre have lowering effects on TC, LDLC, TG and do not decrease HDLC. Fibre decreases serum lipids by bile acid adsorption, and through fermentation products (SCFA) effects on metabolism.
6.	Fermentation of: undigested resistant starch, dietary fibre, oligosaccharides, unabsorbed lactose	CHOs that escape digestion in small bowel are fermented to hydrogen, methane, SCFA, CO ₂ ; this stimulates microbial growth. (Lactose 'malabsorption' is not a pathological state, unless secondary to mucosal disease.)
7.	Bowel habits	Dietary fibre (and to a limited extent, resistant starch) affects laxation, depending on amounts, fermentation and water-holding capacity. Cereal fibre is the most laxative.
8.	Growth of microflora (pre-biotics are foods that stimulate growth of gut bacteria, protecting the host from invasion by pathogenic species)	Fermentable CHOs stimulate bacterial growth in the large gut, and increase biomass and nitrogen excretion, depending on the type of CHO, rate of breakdown, and transit time. Fructo-oligosaccharides stimulate growth of bifidobacteria.
9.	Physical activity	CHOs play an important role in exercise and can increase performance during endurance events.
10.	Behaviour	Consumption of breakfast by children and maintaining blood glucose levels are associated with improved cognitive performance. There is no evidence that sucrose negatively affects the behaviour of children.

* Adapted from the FAO/WHO Consultation.¹

CHOs = carbohydrates; SCFA = short chain fatty acids (acetate, propionate and butyrate); TC = total serum cholesterol; LDLC = serum low-density lipoprotein cholesterol; HDLC = serum high-density lipoprotein cholesterol; and TG = serum triglycerides.

Indians and 24-hour recall data among rural black men, from Table III it is clear that the black South African population still has the highest carbohydrate intake, followed by coloured South Africans. Indian South Africans seem to have even lower intakes than the white population.

To provide at least 55% of the energy of an 8 000 kJ diet (for women) and a 10 000 kJ diet (for men), at least 259 g and 325 g carbohydrate per day should be consumed respectively. When habitual and 24-hour recall intakes of South African men and women are compared (Table III) it seems that black and coloured South Africans generally take in adequate amounts of carbohydrate, while whites and Indians should be encouraged to consume more carbohydrate in relation to other macronutrients. The generally low intake of fibre in all groups emphasises the need to encourage consumption of unrefined or minimally processed carbohydrate-rich foods in all groups. The low, and often deficient intake of several micronutrients,

especially by black and coloured people,² supports the recommendation that fortified cereals and grains should be eaten more often.

EVIDENCE THAT CARBOHYDRATE FOODS INFLUENCE HEALTH AND PREVENT DISEASE

There are many studies available to evaluate if and how carbohydrates or carbohydrate-containing foods influence health. Several approaches can be followed to group and evaluate these studies. A conceptual framework to categorise studies and their outcomes is given in Fig. 1. The figure indicates how epidemiological studies provide data on the relationships between the intake of specific foods, food groups or nutrients and health, risk of disease or specific diseases. Intervention or clinical studies provide data on how effectively or efficiently a particular dietary (food or nutrient) change may

Table III. Mean (\pm standard deviation (SD)) daily carbohydrate intakes in grams for adult South Africans aged 25 - 65 years^{2,3}

Population group	Men				Women			
	Total*	Starch [†]	Fibre [‡]	Sugar [§]	Total*	Starch [†]	Fibre [‡]	Sugar [§]
Urban blacks								
24-h [¶]	282 (112)	211.7	19.5 (13.5)	50.8 (47.8)	222 (89)	161.6	14.6 (8.8)	45.8 (37.9)
Habitual	417 (188)		29.8 (20.5)	123.0 (87.3)	298 (150)		18.6 (9.4)	94.2 (67.6)
Non-urban blacks								
24-h	-	-	-	-	409 (122)	311.0	37.0 16.0	61.0 36.0
Habitual	377 (132)		19.4 (8.8)	33.2 (37.1)	297 (87)	25.1	25.1 (9.2)	44.6 (36.4)
Whites								
24-h	280 (122)	172.2	18.5 (10.6)	89.3 (61.4)	183 (86)	117.5	13.7 (7.8)	51.8 (40.3)
Habitual	324 (129)		26.7 (18.7)	93.6 (60.4)	230 (61)		26.0 (9.4)	51.1 (36.4)
Coloureds								
24-h	240 (106)	147.9	13.7 (8.8)	78.4 (54.1)	177 (79)	103.5	10.7 (6.4)	62.8 (41.9)
Habitual	453 (155)		16.6 (7.3)	155.0 (59.0)	362 (111)		13.7 (6.4)	126.0 (59.6)
Indians								
24-h	231 (88)	141.3	16.9 (8.65)	72.8 (46.2)	164 (62)	102.5	13.1 (6.6)	48.4 (33.3)
Habitual							-	-

* = Total carbohydrates, determined by difference method as given in the South African Food Tables.²⁹[†] = Starch calculated as total carbohydrate — (fibre + sugar).[‡] = Total dietary fibre.[§] = Added sugar (sucrose).[¶] 24-h: Intakes measured using the 24-hour recall method.^{||} Habitual: Intakes measured using a food frequency questionnaire, diet history or weighed records.

influence human physiology and biochemistry and therefore nutritional status and health. *In vivo* or *in vitro* experimental studies provide information on possible mechanisms of action and evidence to support observations from epidemiological and clinical studies.

Using this framework, some recent studies^{5-11,14-28} in which particular effects of dietary carbohydrate and/or cereal foods have been examined, will be discussed.

Obesity

Because carbohydrate, and especially starch, is the main contributor to dietary energy, there are often misconceptions about its role in maintaining healthy body weight and in obesity. A recent WHO Consultation on Obesity⁴ concluded that the bulk of the evidence suggests that carbohydrate and protein balances, but not fat balance, are well regulated; that weight changes are primarily caused by disruption of fat balance; that those macronutrients with a low storage capacity within the body (alcohol, protein and carbohydrate — but not fat) are preferentially oxidised when intakes exceed requirements; and that excess carbohydrate can also be converted to fat, but that human subjects do not use this

metabolic pathway to any appreciable extent unless large excesses of a low-fat, high-carbohydrate diet are consumed.

However, when carbohydrate is oxidised less fatty acid oxidation is required. So, dietary fat is stored and endogenous fat retained.^{4,5} About 60% - 80% of the excess energy may be stored on carbohydrate overfeeding, compared with 96% on fat overfeeding.⁴ Furthermore, fat is much more energy-dense than carbohydrate, containing 38 kJ/g compared with 17 kJ/g. This explains why carbohydrate foods should not generally be regarded as 'fattening'. However, as has been shown for rural black women,⁶ it is possible to become obese on low-fat, high-carbohydrate diets, especially if these diets are accompanied by low levels of physical activity.

Jenkins *et al.*⁷ recently showed in an intervention study that decreased intakes of carbohydrate correlated with a fall in leptin concentration during weight loss. These authors speculated that leptin defends the body's carbohydrate stores and that leptin is involved in the satiating effect of carbohydrate. Their results suggest that dietary interventions that maintain leptin levels during weight loss may lead to improved weight loss. This supports the recommendation that diets should contain adequate amounts of carbohydrate and limited amounts of fat.

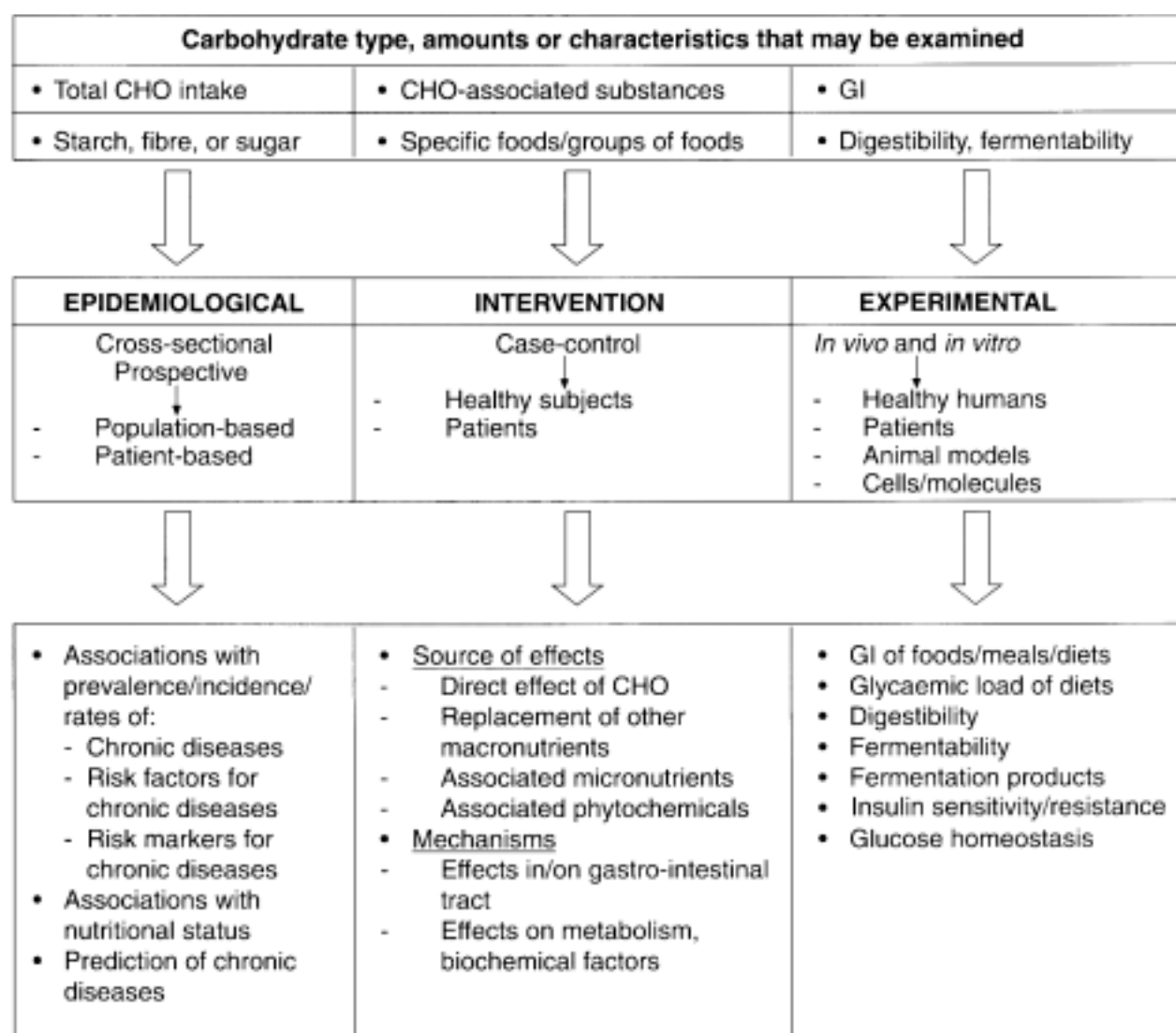


Fig. 1. A conceptual framework of different categories of studies that should be considered to evaluate the relationship between dietary carbohydrates and health (CHO = carbohydrate; GI = glycaemic index).

Non-insulin dependent diabetes mellitus (NIDDM)

The FAO/WHO Consultation on Carbohydrates⁶ concluded that NIDDM is a multifactorial disease with a strong genetic basis. However, available evidence suggests that carbohydrate-containing foods rich in non-starch polysaccharides (dietary fibre) and with a low glycaemic index (GI) protect against the development of NIDDM, the effect being independent of body mass index. High intakes of a wide range of carbohydrate foods are also accepted for the nutritional management of people who have already developed NIDDM.

Sucrose and other sugars have not been directly implicated in the aetiology of diabetes,⁷ and most recommendations permit 30 - 50 g per day for diabetic subjects, provided that this is consumed within the context of the total energy allowance, that it does not replace nutrient-dense and high-fibre foods, and that it is incorporated into mixed meals.⁶ A recent clinical

trial involving NIDDM patients⁸ indicated that a very high-fibre diet, containing 50 g of fibre of which 25 g were soluble and 25 g insoluble fibre, improved glycaemic control, decreased hyperinsulinaemia and lowered plasma lipid concentrations. The overall decrease in plasma glucose concentrations was similar to that typically achieved with oral hypoglycaemic drugs.

Wolever⁹ reviewed the evidence that low GI carbohydrate-containing foods decrease risk of NIDDM, and increase insulin sensitivity. There are indications that undigested, but fermented starch may also influence the haemostatic system, which may be beneficial for diabetic patients. Ceriello and co-workers¹⁰ recently showed that the activation of the haemostatic system by hyperglycaemia in diabetic subjects could be decreased by acarbose, an enzyme that inhibits carbohydrate (starch) digestion in the small bowel. In this

clinical trial acarbose feeding resulted in decreased post-prandial hyperglycaemia and a decrease in plasma prothrombin fragment 1 + 2 as well as plasma D-dimer. The latter two are indicators of coagulation activation. The undigested starch is fermented to short chain fatty acids (SCFAs) in the large bowel. The formed butyrate is metabolised by the colonic epithelial cells, propionate by the liver and acetate by muscle cells.¹¹ It is generally accepted that many of the beneficial effects of starch and fibre can be attributed to the production of these SCFAs.

From the above, it seems that consumption of high-carbohydrate diets which provide carbohydrate substrates for large bowel fermentation, have several benefits for NIDDM patients and probably also for the general population.

Cardiovascular disease

Despite recent decreases in prevalence, CHD remains a major killer in white, Indian and coloured South Africans, while stroke is suspected to be a major problem in the black population.¹² CHD and stroke are both multifactorial diseases in which complex interactions between genetic predisposition and environmental factors, including diet, influence the atherosclerotic and thrombotic process underlying the clinical manifestations of these diseases.

After an extensive review of available evidence, the FAO/WHO Consultation¹ concluded that prospective studies have shown that cereal foods rich in dietary fibre are protective against CHD. Increased intakes of antioxidant nutrients (mainly from fruits and vegetables) and replacement of fatty foods by foods rich in carbohydrate such as cereals should form the cornerstone of dietary advice to protect against CHD.¹ Specific dietary fibre components such as β -glucans found in oats, have been shown to lower serum total and low-density lipoprotein (LDL) cholesterol levels significantly. These foods are useful in management of hypercholesterolaemia, but their role in prevention of CHD remains to be established.¹

Another possible mechanism by which carbohydrate foods may protect against CHD is through effects on high-density lipoprotein (HDL) cholesterol. Frost *et al.*¹³ recently re-analysed data from the 1986 - 1987 Survey of British Adults and found a negative correlation between serum HDL cholesterol levels and the GI of the diet. The GI of the total diet was a stronger predictor of the HDL cholesterol level than dietary fat. These results confirm other observations of an association between low GI foods and high HDL concentrations⁹ and suggest a role for carbohydrate foods in lowering CHD risk.

Strong evidence that whole-grain cereal foods are protective against CHD came from the prospective Nurses' Health Study¹⁴ in which 761 cases of CHD (208 fatal, 553 non-fatal) were documented during 729 472 person years. Increased intakes of whole (unrefined) grains were associated with a decreased risk of CHD (adjusted for age and smoking). The strongest effect

was seen in never-smokers. The authors mentioned that the lower risk of CHD was not fully explained by the grain's contribution to fibre, folate, vitamin B₆ or vitamin E intakes, and speculated that additional protective mechanisms were operative.

The major risk factors for stroke are hypertension and increased plasma fibrinogen, both being prevalent in the black population.¹⁵ Less is known about dietary effects on these two risk factors, but the FAO/WHO Consultation advised that since plant foods are good sources of potassium, increased intake of all plant foods may reduce the sodium-potassium ratio and therefore the risk of hypertension.¹

Cancer

Cancer is a disease associated with well-recognised genetic abnormalities, but diet is regarded as an important risk factor for colorectal, breast and uterine cancers.¹ Meat and fat intakes are associated with increased risk of colorectal cancer, and total energy (leading to obesity) with breast and uterine cancer.¹ Cereal foods, fruit and vegetables are generally regarded as being protective.¹ However, in a recent review, Hill⁶ concluded that it is especially cereals and vegetables that protect against colorectal cancer, while fruit seems to be neutral.

There seems to be agreement in the literature¹⁶⁻¹⁹ about the mechanisms by which carbohydrate foods may protect against colorectal cancer. These include the formation of butyric acid from the fermentation of undigested resistant starch, oligosaccharides and dietary fibre in the large bowel; the dilution of potential carcinogens by these carbohydrates; the reduction of products of protein fermentation through stimulation of bacterial growth; pH effects; maintenance of the gut mucosal barrier; and effects on bile acid degradation. It is thought that the formation of butyric acid, which arrests cell growth, influences differentiation and 'selects' damaged cells for cell death (apoptosis), is the primary protective mechanism.¹ Resistant starch, found in green bananas, cold cooked starches, and minimally processed wheat and maize,^{20,21} is a good source of butyric acid.

Southgate²² estimated that with a 150 g starch intake, about 15 g will reach the colon, depending on the physical structure of the food. The importance of adequate amounts of undigested carbohydrates reaching the colon is being increasingly recognised — not only for butyric acid production, but also for growth and activity of bacteria to synthesise vitamins, to metabolise bile acids and other steroids, and for laxative properties.^{11,21,23}

Other compounds than starch and dietary fibre in unrefined cereals, fruits and vegetables, such as antioxidant micronutrients, phytoestrogens, the phenolic compounds (ferulic and caffeic acid) and the large range of isoprenoids are all thought to protect against various forms of cancer.¹⁷⁻¹⁹

Other gastro-intestinal diseases

Dietary fibre, especially from unrefined cereals, and resistant starch intake increase stool weight and prevent (and can be used in treatment of) constipation, haemorrhoids, anal fissures and diverticular disease. Carbohydrates that are not digested in the small intestine but fermented in the large intestine, and therefore facilitate colonisation of bifidobacteria and lactobacilli, reduce the risk of acute infective gastro-intestinal diseases.

Dental caries

Foods containing sugars and starch are broken down by amylase and bacterial enzymes in the mouth. The produced acid increases caries risk.¹ However, the impact of carbohydrates on caries is dependent on the type of food, frequency of consumption, degree of oral hygiene, fluoride availability, salivary function and genetic factors.

THE GLYCAEMIC INDEX (GI) OF CARBOHYDRATE FOODS

The beneficial effects of low-GI foods have been mentioned above in the context of preventing chronic diseases. This index is defined¹ as the incremental area under the blood glucose response curve of a 50 g carbohydrate portion of a test food expressed as a percentage of the response to 50 g carbohydrate from a standard food (glucose or white bread) taken by the same subject. The methods for determining and calculating the GI of foods, meals and diets, have been described by the FAO/WHO Consultation.¹

Carbohydrates that are slowly digested and absorbed have low GIs. Food form, determining accessibility of digestive enzymes, therefore has a pronounced effect on the GI.²⁴

There is some concern about standardisation of methods to determine GI in different laboratories, and about intra- and interindividual variations in blood glucose responses. Nevertheless, the GI is accepted as a useful tool in choosing carbohydrate foods for specific purposes, because the same foods are mostly categorised as low, medium or high GI foods using existing methods.²⁴ However, in applying the GI to choose foods, it should be kept in mind that the GI reflects the acute or immediate response to the carbohydrate in the food, and that other nutrients, notably fat and dietary fibre, will also decrease GI.

Results from the Health Study²⁵ recently emphasised the possible importance of low GI foods. In this study of an American female population, the total glycaemic load of the diet was positively related to CHD risk in women with a body mass index above 23 kg/m². But the carbohydrates with a high GI were more strongly associated with the increased risk compared with carbohydrates with low GIs when the data were controlled for total energy, protein, fat and carbohydrate. This study underlines that lowering of the GI of the diet by

increasing intakes of unprocessed carbohydrate foods compared with refined products will probably have long-term beneficial health effects. Low GI carbohydrate-containing foods seem to play a role in prevention of chronic diseases, while high GI foods may be the preferred choice in specific circumstances such as restoring glycogen stores after exercise.²⁶

CARBOHYDRATES AND FUNCTIONAL FOODS

Functional foods²⁷ are foods or food products in which composition and other properties have been changed to have specific functions in the body — usually for improving sensory characteristics, shelf life, nutritional status and prevention of chronic disease.

Starchy foods are particularly suitable for development of functional foods because starch content and properties can be modified using various methods. For example, Hoebler *et al.*²⁸ have shown that by substituting high amylo-maize starch for a part of the flour in bread, the GI of the bread can be lowered. Amylose is a straight-chain polysaccharide which is slowly digested, while the branched chain of amylopectin allows multiple access points for digestive enzymes.

Therefore, by changing the amylose/amylopectin ratio of starch in food products,²⁸ or increasing the amount of resistant starch and decreasing rapidly available glucose in foods,²⁹ the GI of the food and its function in the body can be manipulated. As more of these food products become available in future, dietary recommendations on how to incorporate them in healthy diets will have to be developed.

PRACTICAL RECOMMENDATIONS

Cereals and grains are the most economic sources of dietary energy and therefore form the staple food of many developing populations. In South Africa, maize has been traditionally used as staple food, and with the addition of legumes, vegetables and small amounts of animal-derived foods, formed the basis of adequate diets in the past. Today, all South Africans can benefit by eating one or more servings of this food group during each meal, preferably in an unrefined form. A wide choice of different cereals and grains and their products such as breads, porridges, pastas, breakfast cereals as well as 'rice' from maize, wheat, rice, sorghum, and rye are available to bring variety in the diet.

CONCLUDING REMARKS

Because of all the mentioned beneficial effects of carbohydrate foods, and cereals and grains in particular, the dietary guideline 'to make starchy foods the basis of most meals' has a sound scientific base. It is supported by convincing results from epidemiological observations, clinical intervention studies and extensive experimental work on the mechanisms of how

these foods and their carbohydrate constituents influence health and prevent disease. But it is also a practical, affordable and culturally sensitive guideline. South Africa produces sufficient amounts of these foods for its population and starchy foods such as maize, bread and rice are eaten by most South Africans. However, available information suggests that all South Africans will benefit by consuming more unrefined cereals and grains, and many will improve their nutritional status by choosing fortified cereals and grains. With the intended mandatory fortification of maize meal and bread flour in South Africa, this last choice will become increasingly easier.

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EAT PLENTY OF VEGETABLES AND FRUITS EVERYDAY

P Love, N Sayed

Today, eating more vegetables and fruits for better health is a concept with which most of the general public is familiar. However, only in recent times have we really begun to understand the mechanism of action of vegetables and fruits in health promotion and disease prevention. In this paper the scientific evidence to support the implementation of the guideline 'Eat plenty of vegetables and fruits everyday' is reviewed.

Dietary factors may play a role in up to 35% of all human cancers. There is accumulating evidence to support the increased (daily) consumption of fruit and vegetables as a means of protection against cancers. The evidence is especially convincing for a protective effect against cancers of the stomach, oesophagus and lungs. Evidence also supports a protective role of vegetables and fruits against cardiovascular disease, with particular attention to flavonoid intake, as well as potassium, folate and fibre.

Studies on individual nutrient action on disease prevention are still inconclusive. Evidence seems to consistently point to specific vegetables and fruits, such as citrus fruits, onions, garlic, carrots and tomatoes. Encouraging vegetable and fruit intake is still the best overall advice as there are likely to be many other unidentified substances in vegetables and fruits, the effects of which cannot be discounted.

South Africans should be encouraged to explore and enjoy the large variety of vegetables and fruits available in this country. However, the majority of South Africans do not achieve the recommended daily intake of 5 portions (400 g) of vegetables and fruits. Studies on the barriers to eating vegetables and fruits reveal that affordability, availability and taste preferences are primary constraints.

The challenge that faces health educators is advising people to increase vegetable and fruit intake while overcoming barriers to change. Examples of successful individual and broad-based national marketing strategies are available to assist in this endeavour to encourage South Africans to 'Eat plenty of vegetables and fruits everyday'.

Discipline of Dietetics and Human Nutrition, School of Agriculture and Agri-Business, University of Natal, Pietermaritzburg

P Love, BSc Diet Hons, PG Dip Hosp Diet

N Sayed, BSc Diet, PG Dip Hosp Diet, PG Dip Mark Mngt

Throughout history, civilisations across the world have recognised the use of plant material to improve health. Today, eating more vegetables and fruits for better health is a concept with which most of the general public is familiar. However, only in recent times, with new research findings, have we really begun to understand the mechanisms of action of vegetables and fruits in health promotion and disease prevention.

In this paper the scientific evidence to support the implementation of the guideline 'Eat plenty of vegetables and fruits everyday' is reviewed. Evidence to support the role of vegetables and fruits in health promotion and disease prevention is discussed, highlighting the implicated nutrients and food sources. The South African health profile and current vegetable and fruit intakes is reviewed in terms of whether the implementation of this guideline is warranted. Practical strategies to overcome identified barriers and achieve optimal intake are given.

DO VEGETABLES AND FRUITS INFLUENCE HEALTH AND PREVENT DISEASE?

Cancer

It is now accepted that 80 - 90% of cancers are caused by external factors, with dietary factors playing a role in up to 35% of all cancers in humans.¹ Another theory postulates that the human body is adapted to a high intake of plant foods and that cancer may be a disease that results from maladaptation to a reduced intake of plant foods like vegetables and fruits.² Researchers have observed that populations consuming the least amount of vegetables and fruits have a higher incidence and mortality of cancers of the oesophagus (e.g. Iran and China), stomach (Poland and Hungary), and intestine (Britain and North America).³

A review of 46 studies (case control and cohort studies) showed that in the case of the non-hormone-dependent cancers increased consumption of vegetables and fruits (using vitamin C as the marker of consumption) seems to confer the strongest protection. These include cancers of the oral cavity (including larynx and oesophagus), stomach cancer, pancreatic cancer and lung cancer.⁴ The protective effect of greater vegetable and fruit consumption on cancers of the upper digestive and respiratory tract was confirmed again by a review of the results of a large-scale Italian case control study.⁵ In a larger review of 206 human epidemiological studies (prospective cohort and case control studies) and 22 animal studies, Steinmetz and Potter⁵ found that evidence consistently supports the theory that greater vegetable and fruit consumption is protective against cancer. The evidence is especially convincing for a protective effect against cancers of the respiratory and digestive systems — especially stomach, oesophagus and lung cancer.

Undoubtedly, avoiding smoking is the most important

behaviour to reduce the risk of lung cancer, but studies show that daily consumption of vegetables and fruits also confers some degree of protection.^{4,6} A study of 9 958 Finnish men and women (followed up from 1967 to 1991) found that the consumption of apples showed an inverse association with the incidence of lung cancer.⁷ After adjusting for other antioxidant nutrients the researchers concluded that dietary flavonoids may be involved in lowering the risk for cancer. (Apples are high in the antioxidant quercetin — the main source of flavonoids in that study population.)

Vitamin C is the nutrient found to be strongly associated with the reduced incidence of stomach cancer.⁴ The possible mechanisms of action of vitamin C in reducing stomach cancer include its antioxidant ability (traps reactive oxygen metabolites) and its ability to inhibit nitrosation.⁸ Fibre (non-starch polysaccharides) from vegetables and fruits ferment in the large bowel forming short-chain fatty acids (particularly butyrate) which may protect against colon cancer. Possible mechanisms of action include arresting cell growth, promoting cell differentiation, and selecting cells with damaged DNA for apoptosis.⁹

Table I summarises the active substances postulated to assist disease prevention, and Table II the mechanisms of action in cancer prevention.^{3,5}

Table I. Substances in vegetables and fruits that may help protect against disease^{3,5}

Dithiols
Isothiocyanates
Indole-3-carbinol
Allium compounds
Isoflavones
Flavonoids
Protease inhibitors
Saponins
Phytosterols
Inositol hexaphosphate
Dietary fibre
Vitamin C
Vitamin E
Folic acid
Beta-carotene
Lutein
Lycopene
Selenium
D-limonene
Coumarins

S25

Cardiovascular disease (CVD)

A prospective study in Finland¹⁰ found a strong association between vegetable and fruit intake and coronary heart disease (CHD) mortality in men (a similar but weaker association was found in women). Vitamins C and E were found to be

Table II. Summary of possible anticarcinogenic mechanisms of action of substances in vegetables and fruits⁴⁵

Anti-oxidant effects
Effects on cell differentiation
Increased activity of enzymes that detoxify carcinogens
Inhibition of formation of nitrosamines
Altered oestrogen metabolism
Binding and dilution of carcinogens in the digestive tract
Altered colonic milieu (including bacterial flora, bile acid composition, pH, faecal bulk)
Preserved integrity of intracellular matrixes
Effects on DNAmethylation
Maintenance of normal DNA repair
Increased apoptosis of cancer cells
Decreased cell proliferation

protective with no observed association for carotenoids. Another study found that the alpha-tocopherol component of vitamin E is most protective against CHD compared with other dietary components considered.¹¹ (This marked protective effect was also found with wine.) Of the two antioxidant vitamins considered, vitamin C had a stronger negative correlation with CHD mortality rates than beta-carotene. In a 12-year follow-up study in a non-institutionalised elderly population, researchers observed that vitamin C and frequent consumption of vegetables (particularly dark green and orange) may be protective against early mortality and morbidity from heart disease.¹²

Evidence also supports a protective effect of vegetables and fruits against CVD in women. A case control study in women in north Italy observed an inverse association between consumption of carrots, green vegetables and fruit and risk of acute myocardial infarction.¹⁰ A prospective study on 39 876 female health professionals found a significant inverse association between vegetable and fruit intake and occurrence of CVD.¹³

Some epidemiological evidence suggests that flavonoids may be protective against heart disease.¹⁴ Flavonoids inhibit the oxidation of low-density lipoprotein (LDL). Oxidised LDL is believed to promote atherosclerosis. A reduced risk of CHD has been found in men with increased ingestion of dietary antioxidant flavonoids.¹⁵ The major dietary contributors to flavonoid intake in this study were tea (61%), onions (13%) and apples (10%). After adjusting for dietary variables and non-dietary risk factors, the highly significant relationship still persisted. Interestingly, the group consuming the highest level of flavonoid intake also smoked less, drank less coffee, and consumed more dietary energy, vitamin C, vitamin E, and beta-carotene when compared with the group consuming the lowest level of dietary flavonoids.

In a meta-analysis of cohort studies on the relationship between CHD and fruit and vegetable consumption, a fourfold increase in fruit consumption and a doubling of vegetable

consumption was found to be associated with a decrease in risk of heart disease of about 15%.¹⁶ The risk reduction was attributed to the combined effects of potassium (lowers blood pressure), folate (reduces plasma homocysteine), and fibre in fruits and vegetables.

Potassium intake may also be related to the inverse correlation between stroke rates and vegetable and fruit consumption. It is hypothesised that high potassium or dietary fibre intakes lower blood pressure and those who consume vegetarian diets usually display lower blood pressure.¹⁰ Vegetarians have higher fibre intakes than non-vegetarians and also have lower rates of CHD, lower serum total and LDL cholesterol, lower body weights and healthier lifestyles than non-vegetarians (all independent risk factors for CHD).²

Infections

Malnutrition depresses the immune system increasing the likelihood of infections, and prolonging recovery from infections. Vegetables and fruits are an important source of carotenoids — the precursor of vitamin A, which is responsible for maintaining the lymphocyte pool and is involved in the T-cell mediated response to infection. Vitamin A status and infections are therefore interrelated — a poor vitamin A status increases the risk of infections, and infections impair nutritional status. Giving children vitamin A supplements has been shown to reduce complications and mortality from measles, reduced incidences of severe diarrhoea and diarrhoea-related death, and reduced mortality in children with HIV infections.¹⁷ In the case of HIV infection, the immune system is compromised, which increases susceptibility to infection. Fat malabsorption occurs throughout the disease process and may contribute to the low levels of beta-carotene observed.¹⁸ Vegetables and fruits have an important contribution to make to the diet of HIV-positive persons in replenishing beta-carotene and improving vitamin A status.

Cataracts

Epidemiological evidence indicates that subjects who consume fewer than 3.5 servings of vegetables and fruits per day have an increased risk for the development of cataracts.¹⁹ In two prospective studies, increased frequency of consumption of spinach and kale moderately decreased risk of cataract development in women,²⁰ while spinach and broccoli intakes were associated with lowered risk of cataract development in men.²¹ The nutrients implicated in this risk reduction are reported to be the carotenoids lutein and zeaxanthin.¹⁷

WHICH VEGETABLES AND FRUITS SHOULD WE CHOOSE?

Vegetables and fruits are important sources of many vitamins, minerals, fibre and other substances. Studies on individual nutrient action on disease prevention are still inconclusive.

Encouraging vegetable and fruit intake is therefore still the best overall advice. There are probably many other active substances in vegetables and fruits which are as yet unknown, and the interactive and synergistic effect of nutrients in foods cannot be discounted.

Table III^{3,5} outlines the vegetables and fruits identified by research to be most protective against disease. The evidence seems to consistently point to specific vegetables and fruits. People should be encouraged to use more of these foods in their daily diets, yet still exploring and enjoying the large variety of vegetables and fruits available in South Africa. Tables IV²² and V¹⁴ quantify the contribution of selected nutrients in

Table III. Vegetables and fruits most commonly cited as offering a protective effect^{3,5}

Vegetables	
Onions, garlic, red pepper (allium)	
Carrots	
Dark green, pale green, leafy — spinach, cabbage	
Cruciferous — cabbage, broccoli, brussels sprouts, cauliflower	
Tomatoes	
Fruit	
Raw fruit	
Fresh fruit	
Citrus fruit	

Table IV. Nutrients provided by common portions of selected vegetables and fruits²²

Food and portion	Amount of selected nutrient supplied
Avocado, 1 whole	1.5 mg vitamin E*
Banana, 1 medium	181 mg potassium
Brussels sprouts, 1/2 cup cooked	14 µg selenium†
Carrots, 1/2 cup raw	8 268 µg beta-carotene
Guava, 1 medium	7.5 g fibre
Orange, 1 medium	95 mg vitamin C ‡
Red pepper, 1/2 cup raw	4 729 µg lutein
Spinach, 1/2 cup cooked	131 µg folate§
Tomato, 1/2 cup raw	2 725 µg lycopene

Compared with the RDA/DRI of a male 25 - 50 years old, the food portion supplies:
* 10%, †25%, ‡106%, § 66% of the nutrient RDA/DRI.

Table V. Flavonoid and sulphur-containing compounds in vegetables and fruits¹⁴

Total flavonoids (quercetin, kaempferol, myricetin, apigenin)	
Onions	0.035 g/100 g
Apples	0.004 g/100 g
Broccoli	0.01 g/100 g
Sulphur-containing compounds (total glucosinolates)	
Broccoli	0.06 g/100 g
Brussels sprouts	0.2 g/100 g
White cabbage	0.08 g/100 g
Cauliflower	0.05 g/100 g

foods identified as offering protection against disease. It is apparent from these tables that, for maximum protective benefit, several portions of vegetables and fruits should be eaten daily.

Making healthier food choices is only one aspect of striving for a healthy lifestyle. Vegetable and fruit consumption may only be markers for other favourable behaviours that are truly protective. The dietary virtues of the Mediterranean diet are widely extolled, but, as Willet and colleagues²³ note, the Mediterranean people also have other interesting lifestyle factors which may contribute to disease prevention. These include regular physical activity, a sense of community and sharing meals with family, long meal times associated with relaxation and relief from daily stresses, delicious carefully prepared meals, enjoyment of healthy diets and postlunch siestas! Apart from a healthy diet, a balanced and holistic approach to life and health is therefore also advocated.

DOES THE SOUTH AFRICAN HEALTH PROFILE WARRANT THE PROMOTION OF VEGETABLES AND FRUITS?

Cancer

In South African males, the approximate lifetime risk (LR; 0 - 74 years) of developing cancer, excluding skin cancer, is 1 in 7 people for blacks, 1 in 5 for coloureds, and 1 in 4 for whites and Indians. In South African females, the approximate LR of developing cancer, excluding skin cancer, is 1 in 8 people for blacks, 1 in 7 for coloureds, 1 in 5 for Indians, and 1 in 4 for whites. Overall, South African males and females have an LR of developing cancer of 1 in 5 and 1 in 6, respectively.²⁴ The top ten histologically diagnosed cancers are featured in Table VI,²⁵

Table VI. The top ten histologically diagnosed cancers in South Africa, by gender²⁵

Site	Males (lifetime risk)	Females (lifetime risk)
Skin — basal cells	1 in 24.37	1 in 44.17
Skin — squamous cells	1 in 53.41	1 in 99.51
Cervix	NA	1 in 31.66
Breast	NA	1 in 31.95
Uterus	NA	1 in 109.20
Ovary	NA	1 in 185.69
Prostate	1 in 43.79	NA
Non-Hodgkin's lymphoma	1 in 143.36	1 in 208.83
<i>Oesophagus</i>	1 in 44.75	1 in 110.39
<i>Colon</i>	1 in 147.56	1 in 147.56
<i>Lung</i>	1 in 44.55	1 in 139.39
<i>Bladder</i>	1 in 78.02	—
<i>Stomach</i>	1 in 114.14	—
Liver	1 in 127.08	—

NA — not applicable.
Italics indicate sites for which dietary influence is strongly implicated.

with italicised sites indicating those for which dietary influence is strongly implicated.

Proposed mechanisms in the development of cancer include heredity (10 - 20%), and external factors (80 - 90%). The latter includes high dietary intakes of saturated fat, animal protein, nitrites and nitrates; low dietary intakes of fibre, beta-carotene/antioxidants, resistant starch, omega-3 and omega-6 fatty acids; smoking; alcohol; and sunlight.^{24,25}

Cardiovascular disease (CVD)

Undesirably raised total serum cholesterol levels are pandemic among South African adults, with up to 80% of urban population groups affected.²⁶ Heart disease therefore contributes much to the burden of mortality and morbidity from chronic disease of lifestyle (CDL) in South Africa. While national data are not known for the incidence of hyperlipidaemia, review of available studies suggests that there are large variations between populations, with total serum cholesterol levels lowest among blacks.²⁷

Most, if not all, of the risk factors for CHD, namely, hypertension, dyslipidaemia, smoking, non-insulin dependent diabetes mellitus (NIDDM), obesity, physical inactivity and heredity, are common in South African populations with high CHD prevalence (whites, Indians and coloured urban dwellers).^{26,28,29} Among Indians, the high frequency of diabetes mellitus and familial hypercholesterolaemia are probable reasons for their high CHD prevalence.³⁰

Despite the increasing prevalence of hypertension, smoking, obesity and perhaps diabetes mellitus among blacks, CHD is still relatively uncommon. At present they appear to be protected by a favourable lipid profile and a relatively high degree of physical activity. With continued urbanisation and a lipid profile showing signs of transition to that of a typical urban population, the incidence of heart disease is likely to increase among blacks, especially among females older than 35 years where the prevalence of obesity is high.^{31,32}

Stroke is the second most common cause of all deaths in South Africa, especially among 35 - 64-year-olds. Hypertension and NIDDM are common risk factors for all populations, but smoking and hypercholesterolaemia appear to be less important risk factors among blacks. Stroke remains one of the least recognised and least treated CDL in South Africa. With a growing elderly population, the incidence of non-fatal stroke in people older than 75 years is likely to increase, burdening hospital and other resources further.³³

Hypertension is the most commonly reported chronic illness among all South Africans and is a promoter of end-organ damage such as stroke, heart failure and renal disease. Among 16 - 64-year-olds, prevalence of hypertension is lowest for Indians (16%), coloureds (25%) and whites (26%), and highest for urban blacks (33%). Prevalence among the elderly

(> 64 years) is increasing, with whites (40%) having the highest incidence at present. Future increases can be anticipated among blacks, especially elderly black females where obesity is a predisposing factor.^{34,35} Hypertension among urban blacks is not caused by any inherent ethnic differences; previously the incidence of hypertension was a low 2 - 8% among rural blacks. The process of urbanisation may considerably increase the risk of hypertension. This is not unique to South Africa and similar trends have been observed in Kenya, Tanzania and Zimbabwe.³⁴

Proposed mechanisms in the development of hypertension include a high dietary salt intake, low renin status (resulting in salt sensitivity), weight gain, insulin resistance, smoking, alcohol and raised psychosocial stress levels (with a corresponding increase in pulse rate). Whatever the mechanism, it is clear that hypertension and obesity, as well as NIDDM, are all ultimately linked.³⁴

Infections

An overall pattern of a low prevalence of wasting and underweight, but a moderate to high prevalence of stunting and multiple micronutrient (vitamin A, iron and folate) deficiencies which further limit growth, exists among South African children, especially black and coloured children younger than 5 years.³⁶

Undernutrition, especially low vitamin A status, is closely linked to lower immunities. Undernourished individuals, especially children, are more likely to contract diseases, such as diarrhoea, respiratory tract infections and tuberculosis, and to be affected more severely and for longer periods. This can further compromise nutritional status and lead to failure to thrive.³⁷

Diarrhoeal disease and associated dehydration are responsible for thousands of deaths per year in South Africa, especially among young black and coloured children.³⁷ Although a low-cost means of prevention exists, namely oral rehydration solution (ORS), awareness of using ORS to treat diarrhoea and combat dehydration is low among those caring for children younger than 5 years, and, even among those most aware of ORS, correct preparation of the solution is low (< 10%).³⁸

Approximately 100 000 new cases of tuberculosis (TB) occur annually in South Africa, of which 80 000 are notified. While TB (and other respiratory tract infections) is preventable through immunisation, access to health services is poorest where there is greatest need. To date immunisation status is low (24.9%) for poor children living in rural areas.^{39,40}

The prevalence of acquired immunodeficiency syndrome (AIDS) among South Africans is rising. Based on yearly anonymous testing of pregnant women attending antenatal clinics for the first time over a selected period, estimated

prevalence rose from 7,6% (1994), to 10,4% (1995), 14,2% (1996), 17,0% (1997) and 22,5% (1998). Children orphaned by AIDS are also becoming a concern for South Africa.⁴¹

ARE SOUTH AFRICANS EATING SUFFICIENT VEGETABLES AND FRUITS?

What is optimal intake? — The professional's opinion

An intake of at least 5 portions (400 g) of vegetables and fruits per day has become established as a manageable, minimum recommendation by numerous international and national health promotion agencies, producers and retailers.⁴²⁻⁴⁷

How much is 'plenty'? — The consumer's view

Findings from the South African Food-Based Dietary Guidelines Consumer Study conducted in KwaZulu-Natal and the Western Cape⁴⁸ highlighted two ways in which the word 'plenty' could be interpreted: (i) frequency ('as often as possible'; 'every day') and (ii) quantity ('at least 2 per day'). Numerical values ascribed to the word 'plenty' ranged from a minimum of 1 vegetable and 1 fruit a day to as many as 5 - 9 vegetables and/or fruits a day (Table VII).

How many vegetables and fruits are South Africans eating?

Regional and *ad hoc* food and nutrient studies describe black rural dwellers as eating two main meals a day consisting of mealie-meal with green leafy vegetables, wild spinach or pumpkin. When available, some fruits are eaten, usually only by women and children.⁴⁹

Black urban dwellers are reported to eat vegetables and fruits in small amounts, usually one small portion twice a day, with women consuming notably more vegetables and fruits than men.^{36,50-52} Some studies have reported negligible vegetable and fruit intakes among black urban dwellers, such as in the Cape where 29% of black adults (aged 15 - 64 years) reported eating no vegetables or fruits in the previous 24-hour period.⁵³

Few studies have investigated vegetable and fruit intakes of Indian and white urban dwellers. Qualitative descriptions indicate that vegetables are eaten in small amounts at the two

main meals, and may also be prepared with oil, margarine, butter or other types of cooking fat. A variety of fresh, frozen and canned vegetables as well as fresh fruit and fruit juices are eaten, but in small amounts, about 2 - 3 times a week.^{50-54,55}

Overall intakes of vegetables and fruits for South Africans can therefore not be regarded as meeting the global recommendations of 5 portions daily. Such low intakes are further exacerbating the existing dietary pattern of the majority of South Africans, namely, moderate to low carbohydrate, low dietary fibre, and marginal micronutrient intakes.^{36,56}

South Africa is not the only country not achieving a high intake of vegetables and fruits. Recent national surveys in the USA estimate mean consumption of vegetables and fruits to be 3.1 - 3.8 servings/day, with only 23 - 32% of Americans meeting the national recommendation of 5 - 9 servings daily.^{57,58}

WHAT ARE THE BARRIERS TO EATING VEGETABLES AND FRUITS?

Although aware of the health benefits of eating plenty of vegetables and fruits every day, participants of the South African Food-Based Dietary Guidelines Consumer Study conducted in KwaZulu-Natal and the Western Cape⁴⁸ indicated a number of constraints:

- Among black rural, informal urban and formal urban dwellers *affordability* (lack of household income) was cited as a primary constraint on compliance with this guideline. Cost was not mentioned as a constraint among Indian and white urban formal groups.
- For all groups (black, coloured, Indian and white), fruit consumption was strongly related to *availability* and highly contingent on seasonal fluctuations.
- In terms of *household taste preferences*, all groups stated that most resistance to vegetable and fruit consumption came from the children and, in some cases, the men in the household.

Similar barriers to the consumption of vegetables and fruits have been reported elsewhere. Studies among low income, multi-ethnic worksite groups in the USA highlighted the following barriers: perishability, inconvenience, cost, storage difficulties, preparation time, taste dislikes, poor availability, and difficulty changing old habits.^{58,59} In the UK, reported

Table VII. Numerical values ascribed to the word 'plenty'⁴⁸

Participants	Minimum	Maximum
Black rural	2 types/day	3 types/day
Black urban informal	1 vegetable + 1 fruit/day	3 types/day
Black urban formal	At least 1 vegetable + 1 fruit/day	1 - 2 vegetables + 1 fruit/day
Indian urban formal	3 + vegetables, and less fruit/day	3 - 4 vegetables + 4 fruit/day
White urban formal	3 vegetables + 3 fruit/day	5 - 9 vegetables and/or fruit/day

barriers to increased intakes of vegetables and fruits featured cost, complacency and family influences very highly.^{60,61}

STRATEGIES TO OVERCOME BARRIERS TO ACHIEVING OPTIMAL INTAKE

The essential research evidence outlined in this paper is not enough to convince people to change their eating behaviours. Knowing why and what to eat does not always translate into a change in food selection — people eat food, not nutrients. The greater challenge is being able to advise people in simple and practical ways while overcoming barriers to change.

Individual strategies

For any educational messages to have a positive impact on behaviour, they should be adapted and customised to meet the needs and resources of the individual(s) for whom the messages are intended. Table VIII outlines some suggestions for increasing vegetable and fruit consumption,⁵ minimising nutrient loss during preparation, and maximising financial savings. Where food insecurity exists or financial constraints prevent frequent consumption of vegetables or fruits, suggestions for increasing consumption may need to focus more on promoting self-sufficiency, e.g. establishing vegetable gardens.

Marketing strategies

Apart from having a consistent health/nutrition message, the use of multiple strategies to communicate a message can help enhance the effectiveness with which the message reaches the consumer. It is slowly being accepted that when developing such strategies, appropriate behaviour change theories should be incorporated as an effective means of addressing and overcoming barriers to change.^{57,62}

One effort that has followed this trend is the national American '5-A-Day For Better Health' programme with its simple, positive dietary message: 'Eat five or more servings of fruit and vegetables every day'.⁵⁷ The programme has four major components: retail, media, community and research. During at least two promotion periods a year, retailers merchandise the programme in their supermarkets, run newspaper advertisements that provide consumers with supplementary information, give away educational materials, and create interactive events to promote programme awareness. A comprehensive national media campaign provides systematic and focused coverage of events.

At community level, the programme is brought to consumers through the co-operative efforts of health, educational, agricultural and voluntary agencies working with groups in the private sector. Schools, worksites, clinics, farmers' markets

Table VIII. Practical suggestions for increasing vegetable and fruit consumption⁵

Increasing vegetable and fruit intake

- Try a new vegetable and fruit each week
- Double your normal serving sizes of vegetables
- Eat raw and dried fruit and raw vegetables, and drink fruit or vegetable juices, as snacks
- Use fruit in your cereal in the morning (bananas, apples, grapes, berries, etc.)
- Make a fruit salad or try baked fruit for dessert (use fruit in season — apples, bananas, peaches, pears)
- Make fruit kebabs for the kids
- Eat a vegetarian dinner at least once a week
- Enjoy a raw vegetable platter at parties
- Add vegetables to your favourite pasta and rice dishes
- Use vegetables in your egg dishes (onions, peppers, tomatoes, mushrooms)
- Enjoy international cuisine that makes use of vegetables — Spanish paellas, Chinese stir-fries, Greek moussaka, Provençal ratatouille, Mexican enchiladas, Indian curries

Maximising nutrients from vegetables and fruits

- Do your vegetable and fruit shopping weekly and use up as soon as possible
- Check the 'sell-by' dates on packages when selecting
- Do not cut vegetables and fruits and leave to stand exposed to air or soaking in water
- Try using all parts of the plant, e.g. beetroot bulb and leaves, carrot tops
- Cook vegetables for the shortest time, using minimum amount of water

Saving money on vegetable and fruit shopping

- Buy vegetables and fruits in season
- Plan your week's menu before shopping so that you don't buy excess that only spoils
- Store vegetables and fruits properly to maximise shelf-life, e.g. bananas outside of fridge
- When buying in bulk, consider your storage space at home first
- Pre-processed foods cost more, e.g. peeled and cut pumpkin
- Compare the costs of fresh and frozen
- Match the quality/grade of food to suit your intended purpose, e.g. not feasible to use extra choice grade pineapple rings in a punch

and food assistance programmes are utilised to promote the programme and community intervention studies are conducted to determine the effectiveness of the programme.

Findings of the '2 Fruit 'n' 5 Veg Every Day' campaign in Victoria, Australia,⁶³ suggest that significant achievements in increasing awareness and consumption of vegetables and fruits can be made with a relatively small budget mass media promotion, especially when it is part of a more comprehensive programme. This broadly based, multilevel statewide nutrition promotion initiative consisted of a range of communication and social marketing activities.

Communication objectives focused on four target groups: (i) the consumer (primary target); (ii) health and education professionals; (iii) food retailers and food service providers; and (iv) food industry partners. A central feature of promotional activities included a short, intensive burst of television advertising. This was supported by radio and print advertising, and community and industry-based initiatives such as point-of-sale materials, recipe cards and posters distributed through food retailers across the state.

An integrated marketing campaign and co-ordinated efforts from all sectors of the food industry are also some of the strategies used by Canada Health and Welfare in the implementation of their dietary guidelines.⁶⁴

CONCLUSION

There is adequate evidence to support a dietary guideline for increased vegetable and fruit consumption in South Africa. Increased fruit and vegetable consumption also assists in meeting other dietary guidelines, such as increased intakes of starchy foods and decreased intakes of fats. This dietary guideline should therefore not be seen in isolation, but as one aspect of healthy eating that fits in with the other food-based dietary guidelines.

While health professionals may be in agreement as to the necessity of such a dietary guideline, the difficulty comes in trying to achieve consumer behaviour change. Health professionals can do much to accelerate this process by providing individual, regional, provincial and national strategies to overcome barriers to change. It is easy to recommend 'plenty of vegetables and fruits everyday' — the challenge lies in showing the consumer how this can be realistically achieved given their specific constraints.

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MORE LEGUMES FOR BETTER OVERALL HEALTH

C S Venter, E van Eyssen

Objective. This paper reviews the scientific merit and feasibility of the Food-Based Dietary Guideline (FBDG) 'Eat dry beans, peas, lentils and soy regularly'. Beans, peas and lentils are also known as 'pulses'. In this review, legumes refer to pulses and soybeans (which are classified as oilseeds).

Composition and nutrient content. Legumes are rich and economical dietary sources of good quality protein, carbohydrates, soluble and insoluble dietary fibre components and a variety of minerals and vitamins. Pulses have a low energy, fat and sodium content. Although full-fat soy foods are relatively high in fat, they may contribute significantly to polyunsaturated fatty acid intake, including α -linolenic acid, an n-3 fatty acid not commonly found in plant foods.

Non-nutritive compounds. Legumes contain several compounds that have been traditionally considered antinutrients, such as protease inhibitors, phytate, saponins, plant sterols and isoflavones. More recent information suggests, however, that most of these compounds may actually benefit the consumer's health.

Health benefits of legumes. Both protective and therapeutic effects of legume intakes have been documented. Legumes are excellent foods to increase dietary fibre consumption and most individuals can incorporate legumes into their diet without difficulty, particularly if it is done gradually. Including legumes in a health-promoting diet is important in meeting the major dietary recommendations to improve the nutritional status of undernourished as well as overnourished South Africans, and to reduce risk for chronic diseases such as cardiovascular disease, diabetes mellitus, cancer and osteoporosis.

Recommended intakes. The amount of cooked pulses recommended (100 - 200 g/day) should reflect a balance between desirable metabolic effects and possible dietary compliance. Whereas 25 g soy protein per day may be required to obtain a significant hypocholesterolaemic effect, intake of significantly smaller amounts (some soy foods weekly) may provide distinct health benefits.

Conclusion. The time has come for a concerted educational campaign on the health benefits of legumes. Dietitians have an important role to play in this regard.

School of Physiology, Nutrition and Consumer Sciences, Potchefstroom University, Potchefstroom

C S Venter, DSc, RD (SA)

Drybean Producers Organisation, Pretoria

E van Eyssen, B Home Econ, Hons BA

The guideline 'Eat dry beans, peas, lentils and soy regularly' aims to improve the overall health of all South Africans. The health benefits of legumes have been known for millennia. People have grown and used legumes as a dietary staple since early biblical times, long before modern nutrition researchers endorsed their significant health virtues.¹ In an age when nutritionists are emphasising the need to decrease fat intake and eat more starchy foods, legumes fit naturally into the Food-Based Dietary Guidelines (FBDGs).

Legumes can be separated into two classes: (i) oilseeds such as soybeans and peanuts, which are grown for both their protein and oil content; and (ii) grain legumes, including common beans, lentils, lima beans, cowpeas, fava beans, chickpeas (garbanzos) and common peas, which are grown primarily as a protein source. Beans, peas and lentils are also known as 'pulses' from the Latin word 'puls', an ancient bean porridge. The guideline referring to legumes is formulated: 'Eat dry beans, peas, lentils and soy regularly.' This paper focuses on the substantial evidence that increased intake improves health, the amount and frequency of intake needed for beneficial effects, and on practical considerations.

Legumes are unique foods because of their rich nutrient content, including starch, vegetable protein, dietary fibre, oligosaccharides, phytochemicals (especially the isoflavones in soy) and minerals. Their carbohydrate and dietary fibre contents contribute to their low glycaemic indices, which benefit diabetic individuals² and reduce the risks of developing diabetes mellitus.³ Soy protein is now regarded as a 'complete' protein, with a protein digestibility-corrected amino acid score of one, which is equivalent to that of egg albumin.⁴ Substituting vegetable for animal protein may reduce urinary calcium excretion and reduce the risk of osteoporosis.⁵ The dietary fibre components include both soluble and insoluble fibre, which have many health benefits.⁶ The importance of oligosaccharides as prebiotics and their role in the modulation of human colonic microbiota are widely recognised.⁷ The isoflavones genistein and diadzein are unique to soybeans and have several favourable health-promoting effects.⁸ Finally, the minerals in legumes are important in reducing the risk of hypertension.⁹ Increased consumption of legumes may benefit the undernourished sections of the South African population.

Once regarded in Western countries as food for poor people, dry beans continue to gain recognition for their importance in health and have now become a 'health food' for affluent people. South Africans eat about 2.5 kg of beans per year per person. In comparison with countries such as the USA with a per capita consumption of 3.5 kg, UK 5.0 kg, Italy 6.7 kg and Canada 7.1 kg, South Africans should include more legumes in their mealplans. Although the demand for dry beans in South Africa exceeds the domestic supply, beans are imported to supplement local shortages. The most important bean types produced in South Africa are red speckled beans, small white canning beans and large white kidney beans. Canned bean

products account for approximately 20% of total bean consumption, primarily because of their convenience. Soybeans take longer to soak and cook than the pulses, but they are a welcome addition to any dish which requires the inclusion of cooked pulses. Soy flour, soy milk, soy protein concentrates and soy isolates are widely used. Protein isolated from soy beans is spun into fibres and this textured vegetable protein is used to produce soy chunks, soy crumbs and meat extenders.

NUTRIENT AND NON-NUTRIENT PROFILE OF LEGUMES

Some of the major nutrients provided by dry beans and soybeans are shown in Table I.

Table I. Nutrient composition of dry beans and soybeans, expressed per 100 g dry weight^{10,11}

Nutrient	Dry beans	Soybeans
Total fat (g)	1	19
Saturated fat (g)	0.3	2.8
Monounsaturated fat (g)	0.11	4.4
Polyunsaturated fat (g)	0.55	11.2
Ratio of α -linolenic to linoleic acid (mg)	0.252 : 0.301	1.3 : 9.9
Protein (g)	22	36
Carbohydrates	60	30
Stachyose (mg)	1 848	3 300
Raffinose (mg)	336	1 600
Insoluble fibre (g)	11	10
Soluble fibre (g)	6	7
Calcium (mg)	154	276
Magnesium (mg)	172	280
Potassium (mg)	1 140	1 797
Iron (mg)	6.4	16
Zinc (mg)	2.5	4.8
Thiamin (mg)	0.45	0.89
Riboflavin (mg)	0.13	0.87
Niacin (mg)	2.5	1.6
Folate (μ g)	370	375

Fat

Most beans are very low in fat, generally containing no more than 5% of energy as fat.¹¹ The exceptions are chickpeas and soybeans, which contain ~ 15% and 47% of energy as fat, respectively. The predominant fatty acid in beans is linoleic acid, although beans also contain the n-3 fatty acid, α -linolenic acid.¹² The consumption of full-fat soy foods contributes significantly to α -linolenic acid intake (α -linolenic acid makes up ~ 7 - 8% of the total fat).¹² Although soy foods are relatively high in fat, they may still be lower in total fat than the foods they frequently replace, such as meats and cheeses. Soy foods are, however, lower in saturated fat and cholesterol. Furthermore, sterols in soybeans inhibit cholesterol absorption in the small intestine, thereby decreasing serum cholesterol

concentrations.¹³ Several plant sterol-enriched table spreads have recently been launched in westernised countries as a heart-health strategy. The structures of plant sterols are similar to that of cholesterol with an extra methyl or ethyl group and a double bond in the ring structure. Saturated plant sterols, referred to as stanols, have no double bond in the ring structure. Free plant sterols are esterified to increase solubility in the spreads. Esterified plant sterols and stanols in spreads lower total cholesterol and low-density lipoprotein cholesterol (LDLC) by about 8% and 13%, respectively.¹³ Flora pro.activ is such a product sold in large supermarkets in South Africa at about four times the price of the equivalent without plant sterols.

Protein

Dry beans are inexpensive sources of plant protein with potential to be used as substitutes for animal-protein sources. The protein content of most beans (uncooked) averages 20 - 25% by weight, whereas the protein content of soybeans is ~ 36% by weight.¹¹ A serving of beans (125 ml, 100 g cooked) provides 7 g protein or ~ 15% of the recommended dietary allowance (RDA) for protein for a 70 kg adult.¹⁴ Although legumes are recognised as being high in protein, the quality of bean protein is often underestimated.¹² Until recently the protein-efficiency ratio, based on the growth of rats, was the standard method of evaluating protein quality. Rats have a methionine requirement that is 50% higher than that of humans. Consequently, because bean proteins are relatively low in sulphur amino acids (SAAs), the protein-efficiency ratios of beans are quite low. However, the WHO and the US Food and Drug Administration have adopted an alternative method for evaluating protein quality, namely the protein digestibility corrected amino acid score (PDCAAS).¹⁵ This method uses the amino acid score (based on the FAO estimated amino acid requirement for 2 - 5-year-old children) and a correction factor for digestibility to arrive at a value for protein quality. The PDCAASs of most beans are reasonably good, although their overall value is reduced somewhat by their lower digestibility.¹⁶ Some types of soy protein products have PDCAASs of close to one, the same score as that of casein and egg protein.⁴

Interestingly, the relatively low SAA content of beans may actually provide an advantage in terms of calcium retention. It has been estimated that every gram of protein consumed causes urinary loss of 1 mg calcium⁵ (which may appear to be a trivial amount, but may increase dietary calcium requirements markedly, because the average calcium absorption from foods is 30%). The hypercalciuric effect of protein is likely to be at least partially due to the metabolism of SAAs. The skeletal system serves as one of the main buffering systems in the body; as a result, the hydrogen ions produced from the metabolism of SAAs cause demineralisation of bone and excretion of calcium in the urine.⁵ According to Messina¹² human studies showed

that the consumption of soy protein is associated with a markedly lower urinary calcium excretion compared with the consumption of similar amounts of whey protein or a mixture of animal proteins.

Carbohydrates

The total carbohydrate composition of soybeans and dry beans ranges from 30 - 60% and is primarily structural and storage polysaccharides.^{10,11} The main storage carbohydrate is starch with small amounts of monosaccharides and disaccharides such as sucrose. The oligosaccharides — raffinose, stachyose and verbascose — are not hydrolysed in the small intestine because there is no α -galactosidase in the human intestinal mucosa. These saccharides are fermented to short-chain fatty acids (SCFAs) and gas in the colon.¹ Because of the discomfort and social embarrassment associated with flatulence, some people avoid beans entirely. Commercial products such as Beano (AkPharma Inc, Pleasontville, NJ), a digestive aid that contains α -galactosidase, are available so that individuals can eat beans without discomfort. Soy flour derived from a new variety of soybeans that is naturally low in indigestible oligosaccharides produces significantly less gas than that derived from conventional soybeans.¹⁷ Additionally, it is possible to remove substantial amounts of oligosaccharides and to markedly reduce flatulence by changing the water in which beans are boiled one or more times.¹² However, the beneficial effects associated with oligosaccharide consumption will then be diminished. The role of the oligosaccharides found in beans and soybeans in the promotion of bifidobacteria development in the colon is still under study. Favourable effects on gastrointestinal function (faecal bulking and production of SCFAs)^{7,18} as well as on metabolism (reduction of serum cholesterol, improved glucose tolerance^{7,18} and mineral absorption¹⁹) have been found. Because of their potential health benefits, soy oligosaccharides are available as commercial sweeteners in Japan²⁰ and they can be classified as prebiotics.⁷ Prebiotics are defined as nondigestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improve host health. Favourable bacterial populations, such as bifidobacteria, can promote health by inhibiting pathogenic bacteria such as *Clostridium perfringens* and *Escherichia coli*.⁷

Micronutrients

Dry beans and soybeans are low in sodium but are excellent sources of minerals, including calcium, copper, iron, magnesium, phosphorus, potassium and zinc.^{10,11} The content and bioavailability of minerals vary according to the processing methods and phytate content.²¹ Beans are a good source of iron; one serving (100 g or half a cup cooked) provides 2 mg, which compares favourably with the iron RDAs of 10 mg and 15 mg

for adult men and premenopausal women, respectively.¹⁴ However, iron availability from legumes is poor and thus their value as a source of iron is limited.²² The availability of zinc and calcium, on the other hand, is relatively good — 25% and 20%, respectively.¹² Calcium bioavailability from soybeans and soy foods is quite good despite the presence of phytate and oxalate.²³

Dry beans and soybeans are good sources of water-soluble vitamins, especially thiamin, riboflavin, niacin and folate, but poor sources of fat-soluble vitamins and vitamin C.¹⁰ In terms of meeting the RDAs for adults, a one-cup serving of cooked dry beans can provide 30% of the required folate, 25% of thiamin, 10 - 15% of vitamin B₆ and < 10% of niacin and riboflavin.¹

Fibre (non-starch polysaccharides)

From Table I it is clear that dry beans are excellent sources of dietary fibre or non-starch polysaccharides because they contain substantial amounts of soluble components, which significantly lower cholesterol and blood glucose concentrations, and insoluble components, which aid gastrointestinal function because of their bulking properties, hydration capacity, binding properties and fermentability. Legume fibre has more hydration capacity than cereal brans.¹ Soy fibre measurably lowers the postprandial increase in serum glucose concentrations, but has only a modest effect on serum cholesterol concentrations.²⁴ Most soy foods, including soybeans, soy flour, textured soy protein and tempeh, are rich in fibre. However, isolated soy protein does not contain dietary fibre.¹⁰

Non-nutritive components

Beans contain several components traditionally considered to be antinutrients, such as trypsin inhibitors, phytate (inositol hexaphosphate) and saponins.²⁵ More recent information suggests, however, that some of the so-called antinutrients may actually benefit the consumer's health. Trypsin inhibitors from beans can certainly interfere with protein digestion, cause pancreatic enlargement and enhance chemically induced pancreatic tumours in some animal species.¹² However, boiling dry beans generally reduces the trypsin inhibitor content by 80 - 90%.¹² In humans, harmful effects have only been reported in instances where the beans were not properly cooked.²⁵ In contrast to the trypsin inhibitor, the chymotrypsin and trypsin inhibitor (Bowman-Birk inhibitor) found in beans, especially soybeans, has anticarcinogenic activity in various tissues in animal models.^{3,26}

Phytate is largely responsible for the poor iron bioavailability from soybeans.²⁷ On average, the phytate content in beans is 1 - 2%.¹² However, phytate has antioxidant effects, the phytate content in beans is 1 - 2%.¹² However, phytate has antioxidant effects, and may lower the risk of colon and breast cancer.²⁸

The saponins in legumes are triterpene glycosides, which are very poorly absorbed by humans.²⁵ Most saponins form insoluble complexes with 3- β -hydroxysteroids and are known to form large, mixed micelles with bile acids and cholesterol.¹² Although saponins were shown to lower cholesterol in some animal species, the hypocholesterolaemic effects of saponins in humans are more speculative.²⁹ Saponins may have anticancer properties, as suggested by a study in mice.³⁰

Isoflavones are another group of phytochemicals (plant chemicals) in beans, but the soybean is the only nutritionally relevant source of these compounds. The isoflavones are strikingly similar in chemical structure to mammalian oestrogens.³¹ They are currently being studied for their potential role in the prevention and treatment of a range of hormone-dependent conditions, including cancer, menopausal symptoms, cardiovascular disease and osteoporosis.³¹ The primary isoflavones in soybeans are genistein and daidzein and their respective β -glycosides genistin and daidzin. Smaller amounts of glycitein and its glycoside, glycitin are present. Although isoflavones are weak oestrogens, the current hypothesis is that isoflavones exert anti-oestrogenic effects in a high-oestrogen environment, such as exists in premenopausal women, and oestrogenic effects in a low-oestrogen environment, such as exists in postmenopausal women.¹² Soy isoflavones also have antioxidant properties¹⁰ and are now being extracted and sold as supplements.

The total amount of isoflavones in soy products varies with the type of soybean, geographic area of cultivation and processing.¹⁰ Products that contain most of the bean, such as roasted soybeans, soy flour and textured soy protein are excellent sources and provide 5.1 - 5.5 mg isoflavones/g protein. Alcohol-extracted products such as soy-protein concentrate, have lower amounts (\leq 0.3 mg/g protein). The threshold intake of dietary oestrogens necessary to achieve a biological effect in humans appears to be 30 - 50 mg/day, which is readily attainable by the inclusion of modest amounts of soy foods in the average Western diet.¹²

PUBLIC HEALTH PROBLEMS ADDRESSED BY THE GUIDELINES

From the above discussion of the nutrient content of legumes, it is clear that their contribution of protein, carbohydrate and micronutrients will contribute to address undernutrition. But the total composition of legumes also makes them ideal foods to include in diets that aim to reduce risk of chronic disease or therapeutic diets to treat these diseases.

Atherosclerotic cardiovascular disease

Cardiovascular disease (CVD) is a major medical and public health concern in all population groups in South Africa.³² Dietary interventions to reduce the risk of CVD include

attention to the consumption of types of fatty acids, dietary fibre, isoflavones and antioxidants.¹ Dry beans and soy foods contribute to all these areas.

The role of fatty acids

Dry beans are essentially fat-free and act to displace fat from the diet. Many soy foods have moderate amounts of oil that is predominantly unsaturated, as discussed above. Although the effects of the different fatty acids in foods on the risk of CVD are much more complex than previously recognised, the low saturated-fat content of soy, and the presence of α -linolenic acid (an n-3 fatty acid not commonly found in plant foods)¹² makes soy foods a good choice for a heart-healthy diet.

The role of dietary fibre

Dietary fibre has major protective effects against CVD.³³ Epidemiologic data suggest that the intake of carbohydrates and dietary fibre is inversely related to CVD.³³ Whereas soluble fibre clearly decreases total serum cholesterol and LDLC concentrations,⁶ the inverse relation between dietary fibre intake and CVD appears to be independent of serum cholesterol concentrations.⁶ It seems more closely related to cereal fibre intake (which predominantly reflects insoluble wheat fibre) than to fruit and vegetable sources of soluble fibre.³⁴ There is relatively little support from epidemiological studies that dried beans, peas or soybeans may prevent CVD.³⁵ Glone *et al.*³⁶ reviewed the results of clinical studies in humans on the effect of soluble fibre on serum lipids and reported significant reductions in total cholesterol (TC) and LDLC levels in 88% and 84% of the studies reviewed, respectively. Most clinical trials in humans have used either high-fibre food or fibre supplements.⁶ The hypocholesterolaemic effects of dry beans have been demonstrated repeatedly.¹ Studies using a variety of dry beans (brown beans, lima beans, chickpeas, kidney beans, navy beans and pinto beans) in amounts varying from 75 g to 200 g dry weight daily confirmed that dry bean consumption significantly lowers serum cholesterol concentrations in humans.¹ The changes in TC were consistent and statistically significant, with a median of -9.7% and a range from -5.2% to -18.7%. Bean intake lowered cholesterol most effectively in inpatient studies (median: -14.1%) v. outpatient studies (median: -8.5%), and most effectively in persons whose initial serum cholesterol levels were highest.¹ Canned beans in amounts varying from 69 g to 150 g daily decreased TC in the range of -1.4% to -16.3%, with a median of -11.7%.¹

Soy-fibre supplementation has a modest hypocholesterolaemic effect in humans.^{6,24} Because most of the studies have used isolated soy protein that does not contain soy fibre, the hypocholesterolaemic effects of soy protein were unrelated to soy-fibre intake.³⁷ Soybeans, with or without their fibre, appear to decrease serum cholesterol concentrations through their protein or isoflavone contents.³⁷ In a meta-analysis, Anderson *et*

*al.*³⁷ reviewed 38 controlled clinical trials examining the effect of soy protein, either textured or isolated, on serum lipid concentrations. Soy-protein intake averaged 47 g/day in these studies. Of the 38 studies, 34 (89%) reported improved serum lipid and lipoprotein profiles (TC -9.3%, LDLC -12.7%, triglyceride -10.5%, HDLC +2.4%). According to these studies changes in lipid concentrations were independent of changes in body weight and dietary intake of total fat, saturated fat and cholesterol. An intake of 25 g of soy protein is generally regarded as sufficient to lower TC concentrations in individuals with initial cholesterol concentrations > 5.7 mmol/l.³⁷ Furthermore, substituting soy protein for animal protein enhances the hypocholesterolaemic effect of the National Cholesterol Education Program (NCEP) Step 1 diet in both normocholesterolaemic and hypercholesterolaemic men.³⁸

The proposed mechanisms for cholesterol reductions by beans and soybeans are reviewed by Geil and Anderson,¹ Venter,⁸ Anderson *et al.*¹⁰ and Lo *et al.*²⁴ The soluble fibre in foods such as beans alters cholesterol metabolism at gastrointestinal, hepatic and peripheral sites. Possible explanations for the hypocholesterolaemic effects of fibre include changes in cholesterol and bile acid absorption and reabsorption, effects of SCFAs, and decreased serum insulin levels.¹ The hypocholesterolaemic mechanisms of soy foods are still under investigation. Small peptide components, individual amino acid ratios, non-protein components such as isoflavones or a combination of factors may alter lipoprotein metabolism. Possible mechanisms include enhancement of bile acid excretion, reduced cholesterol metabolism, increased thyroid hormones, and reduced insulin-to-glucagon ratios.¹⁰ The isoflavone genistein inhibits atherosclerotic lesion development by inhibiting cell adhesion, altering growth factor activity and inhibiting cell proliferation.³⁹ Furthermore, genistein inhibits thrombin formation and platelet activation³⁹ and LDLC oxidation *in vitro*.¹⁰

Diabetes mellitus

Dry beans and soy foods offer benefits in the prevention of diabetes and in the clinical management of established diabetes. Legumes reduce the risk of developing diabetes because of their high-fibre, low-fat content and low glycaemic indices. In carefully controlled studies, a significant inverse association between total dietary fibre intake and risk of type 2 diabetes was reported.⁴⁰ Additional observations suggest that foods with low glycaemic indices (GIs) such as legumes were protective whereas foods with high GIs had a positive correlation with risk.³ Legumes are slowly digested and produce low glycaemic and insulin responses. Vorster *et al.*⁴¹ reported a GI of 29 for butter beans with a small increase in GI when 15 g of sugar was added. The mean GI for kidney beans reported by various authors is 27, for lentils 29, chickpeas 33,

canned baked beans 48 and for soy beans a very low 18.⁴² Legumes are rich in soluble fibre, phytates and tannins, all of which correlate inversely with carbohydrate digestion and glycaemic response.² In subjects with glucose intolerance, dry beans,⁴³ soy protein isolate⁴³ and soy-fibre⁴⁴ improve glucose tolerance and insulin response.

Substituting soy protein for animal protein may further protect diabetic individuals from diabetic nephropathy.⁴⁴ Anderson *et al.*⁴⁴ recently proposed, on the basis of available evidence, that the increased glomerular filtration rate (GFR) after the ingestion of animal protein is absent or mild with soy protein. Limited evidence suggests that protein from dry beans may also have renal protective effects, but more investigation is required to confirm this.⁴⁵

Cancer

The role of legumes in cancer prevention is unclear. Most reviews on this topic generally indicate that among epidemiological studies, about as many studies suggest an inverse association as a positive association between intake of legumes and cancer risk.⁴⁶ In a recent report concerning the association of legumes with cancer risk, it was noted that 58 epidemiological studies have examined this association.⁴⁷ Of these, 29 reported a decreased risk with higher intake whereas 22 reported an increased risk. Overall, no conclusions concerning the role of legumes in cancer risk could be reached based on this literature.⁴⁷

The evidence indicating that soy food intake has a protective effect against various types of cancer is stronger than for dry beans.^{26,48} However, on the basis of these reviews, including *in vitro*, animal and epidemiological results, it is clear that the data are insufficient to conclude that soy consumption is protective, and yet the data certainly warrant continued investigation of this relation. The data suggesting that soybeans may reduce risk of prostate cancer are more encouraging than for postmenopausal breast cancer.¹² Besides isoflavones, there are a number of phytochemicals in soybeans with demonstrated anticarcinogenic activity. These include phytosterols, phytates, saponins, protease inhibitors and a variety of phenolic acids.^{12,26} However, most of the data point toward the isoflavones as being responsible for the hypothesised anticancer effects of soy.

OTHER HEALTH CONSIDERATIONS

Osteoporosis

Soy isoflavones are proposed to preserve bone mineral density.¹² Animal studies support the potential benefits of soy isoflavones on bone mineral density and preliminary human studies also support the potential role of soy isoflavones in increasing bone mineral density in postmenopausal women.¹² Potter *et al.*⁴⁹ recently reported a significant increase of 2% in

both bone mineral content and density in the lumbar spine of postmenopausal women after 6 months on a diet including 40 g protein per day from isolated soy protein containing 2.25 mg isoflavones/g protein. Isoflavones may to some degree inhibit osteoporosis, but as a single prevention strategy may be insufficient for complete protection.⁵⁰ Demonstrating effects on bone density requires long-term studies, and compliance to soy foods is a major problem that must be addressed in the design of human studies.

Menopausal symptoms

It has been claimed that diet can offer potential relief of the symptoms of the menopause, with vegetarians reporting fewer symptoms, although much of the evidence is anecdotal. Hypothetically, soy isoflavones have the potential to provide an exogenous source of oestrogen. The lower incidence of menopausal symptoms in women in countries consuming soy as a staple has been attributed in part to the intake of isoflavones.³¹ A number of clinical trials of soy foods have been conducted in postmenopausal women aimed at evaluating the effects on hot flushes and vaginal cytology. Results and conclusions have been variable but promising with regard to an oestrogenic effect. However, a strong placebo effect has been observed.^{31,51} Further studies must address the issue of dose response. Given the difficulty of compliance to soy diets, probably this could best be done using supplements.⁵¹

PRACTICAL CONSIDERATIONS

Legumes are ideally suited to meet two major dietary recommendations for good health — intake of starches and decreased consumption of fat. Dry beans and soybeans are also good sources of quality protein and can be substituted for animal protein sources. Soybeans provide unique isoflavones which may be of benefit in the prevention of many of the common diseases seen in Western populations in which the diet is typically devoid of these bioactive non-nutrients. Numerous studies have shown the beneficial effects of an intake of 100 - 200 g cooked dry beans per day on the risk markers of chronic diseases of lifestyle without any harmful effects.²⁵ Whereas 25 g soy protein per day may be required to obtain a significant hypocholesterolaemic effect,³⁷ intake of significantly smaller amounts of isoflavone-rich foods (some soy foods weekly) may provide distinct health benefits as well.¹⁰ A guide to using legumes in practical ways is provided in Table II. Most consumers can find ways of incorporating legumes into their daily diets. The health advantages far outweigh the slight inconvenience involved in changing shopping habits and eating patterns. The key to dietary change is the repetition of dietary education by health professionals. Dietitians should take up the challenge of a concerted campaign to educate all South Africans on the health benefits of dry beans, peas, lentils and soy.

Table II. Practical applications of legumes*

Food and serving size	Application
Dry beans, peas and lentils (100 g, 1/2 cup canned or cooked)	Use in soups, salads, stews, casseroles, samp and beans, lentils and rice, pork and beans, baked beans, three-bean salad, 'sousbone', chili con carne, curried butter beans, chakalaka with beans
Soymilk/beverage (250 g, 1 cup)	Lactose free, available plain or flavoured, used in much the same ways as cow milk
Isolated soy protein (30 g)	Found in many commercially prepared products; the powder can be added to almost any recipe or beverage
Textured soy protein (250 g, 1 cup)	Compressed soy flour; the protein fibre changes the structure; rehydrate with 7/8 cup boiling water; replace part or all of the meat in any recipe
Concentrates (90 - 120 g)	In packaged convenience foods, e.g. frozen burgers, sausages, meat analogues
Tofu (120 g)	The result of curdling hot soymilk with a coagulant — absorbs flavour of other ingredients; use in stir-fries, soups, casseroles, salads, dips and salad dressings

* Adapted from Anderson *et al.*¹⁰**References**

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FOODS FROM ANIMALS CAN BE EATEN EVERY DAY — NOT A CONUNDRUM!

S C Scholtz, H H Vorster (jun), L Matshego, H H Vorster

The guideline 'Meat, fish, chicken, milk and eggs can be eaten every day', is motivated by reviewing the evidence that these foods contribute valuable nutrients to the diet, preventing undernutrition of especially calcium, iron, zinc, and the essential omega-3 fatty acids. In addition, the evidence that overconsumption of these foods increases risk of chronic diseases is evaluated, with particular emphasis on the role of saturated fats, omega-3 fatty acids and cholesterol in relation to the risk of coronary heart disease and cancer.

Foods from animals, as stated in the guideline, include: milk and other dairy products such as yoghurt and cheese; fish, both fresh and tinned fresh water and marine fish; eggs; and meat, both red meat and chicken. Compared with plant foods, these foods are relatively expensive and economic circumstances will often dictate intakes. The available literature shows that with urbanisation, intakes of animal-derived foods by black South Africans are increasing, leading to more adequate diets and better nutritional status. Intakes of meat in the other population groups are generally high, which may be related to an increased risk of some chronic diseases. However, intakes of milk in most populations and fish in some population groups are low.

The literature further indicates that it is possible, but difficult, to achieve adequate and balanced diets without inclusion of foods from animals. It seems that 400 - 500 ml of milk or its equivalent per day, two to three servings of fish per week, about four eggs per week and alternatively not more than 560 g of meat per week, will improve nutritional status without increasing risk of chronic diseases. However, low-fat products should be chosen and fats should be used sparingly in the preparation, cooking and serving of these foods. It is emphasised that these products are expensive, but that small additions of animal-derived foods to a plant-based diet could result in improved nutrition.

It is concluded that this guideline may be difficult to achieve in some population groups and that substantial nutrition education of consumers would be necessary to change behaviours so that these foods are consumed in the recommended quantities to ensure optimal and adequate, but prudent dietary intakes.

The guideline 'Meat, fish, chicken, milk and eggs can be eaten every day', was formulated to indicate that meat, poultry, fish, eggs, milk and other dairy products have a place in a healthy, balanced diet, but that carefully chosen vegetarian diets can also be adequate without these foods. The strongest argument for including foods from animals in the daily diet is that they are the best sources of high-quality protein and excellent sources of essential micronutrients such as iron, zinc, calcium, thiamine, riboflavin and the omega-3 fatty acids. Moreover, these micronutrients are more bioavailable than in plant foods. Animal-derived foods even increase availability of micronutrients in plant foods when they are eaten together. The argument to limit intakes of foods from animals is based on evidence that overconsumption of some may increase risk of chronic diseases, particularly cardiovascular disease and certain forms of cancer. However, the main constraint to including these foods in the diet is that compared with plant-derived foods, they are expensive.

The objectives of this article are:

- to review the evidence that foods from animals play an important role in preventing undernutrition
- to evaluate the evidence that over-consumption increases risk of some chronic diseases
- to compare guidelines regarding these foods in other countries
- to explore present consumption patterns and quantities of these foods consumed by South Africans, and based on existing evidence
- to indicate optimal amounts that could be eaten to ensure adequate nutrition without increasing risk of chronic disease. This quantitative information is important when applying the guideline in consumer nutrition education.

ADDRESSING UNDERNUTRITION

Despite advances made during the past decade to reduce undernutrition, it remains a serious global problem.

Underwood¹ recently reviewed the situation and concluded that in 2000, an estimated 182 million children, mainly from developing countries, were stunted, while 150 million were underweight. Furthermore, approximately 30 million children are born undernourished annually, which is indicative of serious undernutrition in pregnant women. Underwood¹ also

School of Physiology, Nutrition and Consumer Sciences, Potchefstroom University, Potchefstroom

S C Scholtz, MSc (Nutr)

H H Vorster (jun), MSc (Diet), RD (SA, UK)

L Matshego, Honn (Cons Sc)

H H Vorster, DSc, (Phys)

quoted data indicating that an estimated 3.5 - 5 billion people are iron deficient, 2.2 billion are iodine deficient and 140 - 250 million are vitamin A deficient. Global deficiencies in macronutrient and micronutrient intakes and status are reflected in segments of the South African population. Although national data on older children and adults are relatively scarce, an analysis of the most recent available literature² indicates that at least 22% of preschool children are stunted, with the 1 - 3-year-old group most severely affected, as well as those living in rural areas and on commercial farms in particular. Vitamin A, iron and folate deficiencies which are prevalent in pre- and primary school children are also seen in adolescents and adults.³ A meta-analysis of nutrient intakes of South Africans⁴ shows that intakes of several micronutrients, notably calcium, iron, magnesium, zinc, riboflavin, vitamins A, B₆, C and folate are low. The new perception¹ that low intakes of micronutrients not only result in the known clinical deficiencies such as anaemia, goitre and eye problems, but also compromise immune function, cognitive development, growth,

reproductive performance and work productivity, underlines the seriousness of the situation.

Therefore, the question to be answered is whether promotion of intakes of foods from animals will address and alleviate undernutrition. In addition to the 'theoretical' assumptions regarding their nutrient contribution, there is supportive empirical evidence. For example, Ahmed *et al.*⁵ showed that in the Ethiopian highlands, improved smallholder livestock technologies played a significant role in improving food security and nutritional status. Table I lists guidelines from 16 different countries,⁶⁻¹⁰ indicating that most have specific guidelines promoting intakes of dairy, fish or calcium and iron-containing foods. However, these guidelines are mostly coupled with advice to choose low-fat foods and products, reflecting the perception that foods from animals are important to help meet nutrient needs, but that consumption should not lead to high saturated fat intakes and increased risk of chronic disease.

Table I. Guidelines related to intakes of dairy, meat, fish and eggs of other countries⁶⁻¹⁰

Country	Date	No. of guidelines	Title of relevant guidelines
Australia guidelines	1992	10*	(9) Eat foods containing calcium — this is particularly important for girls and women. (10) Eat foods containing iron — this applies particularly to girls, women, vegetarians and athletes
Canada guidelines	1997	5	(3) Choose lower-fat dairy products, leaner meats, and foods prepared with little or no fat
China guidelines	1995	8	No direct guidelines. (3) Moderate oil and fat intake. (8) Balance food distribution for three meals
Denmark guidelines	1996	7	(4) Eat fish often or fish products to be put on bread — choose different ones. (5) Choose milk products and cheese with a low content of fat. (6) Choose meat or meat products to be put on the bread with a low content of fat
France guidelines	1997	7	No direct guideline. (4) Do not abuse fats
Federal Republic of Germany guidelines	1994	10	(4) Eat sufficient protein. (5) Avoid too much fat. (7) Eat fresh food (fruit, juices, vegetables, milk) and whole grain products daily
Hungary guidelines	1988	10	(5) Drink half a litre of low-fat milk per day
India steps to healthy eating	1998	5	(3) Pulses/nuts, milk and milk products, fish and chicken: eat moderately. (4) Eggs and flesh foods: eat less
Indonesia guidelines	1995	13	(6) Consume iron-rich foods. Indirect guidelines on fats and oils (4) as well as breast-feeding (7)
Japan	1985	5	No direct guideline. (1) Eat a variety of foods (N = 30 or more different kinds of foods per day!) (3) Be aware that the type of fat is as important as the quantity
Korea guidelines	1997	10	(3) Consume enough protein. (4) Keep fat consumption at 20% of energy intake. (5) Drink milk every day
Malaysia guidelines	1996	7	No direct guideline. (4) Low-fat, low-cholesterol guideline (7) breast-feed
New Zealand guidelines	1991	6	
Norway guidelines	1997	10	(3) Replace full milk by light or skimmed milk, and choose other dairy products with less fat on weekdays. (5) Eat more fish of all types for putting on bread and for dinner. (6) Choose lean meat products
Philippines guidelines	1997	5	No direct guidelines. (2) Promote breast-feeding and proper weaning
USA guidelines	2000	10	No direct guideline. (3) Let the pyramid guide your food choices. (7) Choose a diet low in saturated fat and cholesterol and moderate in total fat

*Of the set of national guidelines, the numbers indicated in brackets refer to animal foods.

Table II. Nutrient composition of selected foods from animals per 100 g

Nutrients	Full fat milk,* fresh	Low fat milk,* fresh (2%)	Eggs* (whole raw)	Eggs* (whole, n-3 enriched)	Chicken* (white meat, raw)	Beef,* topside mince, cooked	Pilchards [†] in tomato sauce (drained)
Energy (kJ)	262	213	616	588	491	913	744
Protein (g)	3.2	3.3	12.6	13.5	23.0	30.4	16.4
Cholesterol (mg)	10	7	419	280	41	88	61
Fat (g)	3.4	2.0	10.3	9.5	2.7	10.7	12.0
<i>Trans</i> fatty acids (g)	Tr	0.13	-	-	Tr	0.39	-
Saturated fatty acids (g)	1.90	1.28	3.03	2.81	0.75	5.34	3.09
Mono-unsaturated fatty acids (g)	0.84	0.59	4.01	4.40	1.05	4.40	3.67
Polyunsaturated fatty acids (g)	0.10	0.06	1.36	2.10	0.68	0.43	4.30
Carbohydrate (g)	4.8	4.9	1.2	0.4	0	0	0.5
Calcium (mg)	120	122	39	39	14	14	240
Iron (mg)	0.1	0.1	1.8	1.8	1.1	2.6	2.3
Magnesium (mg)	12	12	9	9	28	26	34
Potassium (mg)	157	152	98	142	309	305	341
Sodium (mg)	48	46	126	188	43	77	414
Zinc (mg)	0.38	0.39	1.15	1.15	0.74	4.60	1.40
Vitamin A (µgRE)	47	24	66	66	8	0	70
Total carotenoids (µg)	19	16	Tr	Tr	Tr	0	-
Vitamin D (µg)	0.03	0.01	7.94	7.94	0.20	0.70	6.79
Vitamin E (mg)	0.11	0.07	3.48	8.70	0.13	0.05	0.46
Thiamin (mg)	0.02	0.02	0.13	0.13	0.13	0.22	0.04
Riboflavin (mg)	0.16	0.16	0.40	0.40	0.08	0.19	0.23
Niacin (mg)	0.1	0.1	0.1	0.1	5.7	4.7	4.2
Vitamin B ₆ (mg)	0.035	0.034	0.042	0.042	0.610	0.466	0.123
Folate (µg)	5	5	46	46	1	13	24
Vitamin B ₁₂ (µg)	0.4	0.4	1.9	1.9	0.2	2.1	9.0

* Sayed *et al.*¹¹[†] Langenhoven *et al.*¹²

Tr = traces.

Table II gives the nutrient composition of some foods from animals, indicating that they are excellent sources of protein, and except for vitamin C, also of the micronutrients often deficient in the diets of many South Africans. (The table also shows that low-fat options are available.) The nutrient density of these foods, addressing known deficiencies, poses the question whether these foods are essential in the diet.

VEGETARIAN DIETS

The health benefits of vegetarian diets have been extensively reviewed and examined.¹³⁻¹⁵ There is agreement that vegetarianism is associated with lower risk and incidence of cardiovascular disease, hypertension, arthritis, colon and

prostate cancer and also with lower total mortality. These beneficial effects are probably not only a result of difference in meat consumption, but often due to increased intakes in fruits and vegetables, as these foods are the primary contributors of phytochemicals believed to reduce disease risks.¹⁶ Vegetarian diets may also contain more fibre, another factor associated with reduced disease risks.¹⁷ Also, although there are exceptions, vegetarians typically use no tobacco, use alcohol in moderation if at all, and may be more physically active than other adults. Researchers must, therefore, account for the effects of these lifestyle differences on disease development before they can determine how health correlates with diet.¹⁸

Parsons *et al.*¹⁸ observed lower bone mineral density in adolescents who followed a macrobiotic diet, an extreme form

of vegetarian diet, at a time of great importance for bone development. However, if parents ensure that their children consume milk, cheese, and other milk products regularly, they will probably ingest sufficient amounts of calcium for normal bone development. Another point of concern is growth, since without meat, eggs, milk and other animal foods children's growth may often lag behind the growth of peers.¹⁹ It has also been shown that even if children take in equal amounts of plant protein compared with their counterparts' intake of animal protein they may not grow as well.²⁰ A possible reason could be that foods of plant origin generally offer much less energy for their bulk than foods of animal origin. Since a child's stomach is small, a vegetarian child might feel full before eating enough food to supply needed nutrients and energy for sufficient growth. It is, however, also true that meat itself is not necessary for children to achieve healthy growth. Many children grow normally when milk and eggs accompany a vegetarian diet and when the diet is planned with proper help and care.²¹

Meat eaters can generally rely on their diets during critical times of life. However, a vegan woman who doesn't meet her nutrient needs may enter pregnancy with inadequate stores of iron, zinc and vitamin B₁₂. Breast-fed infants from these mothers can often develop a fatal disorder characterised by body tremors, facial twitches, psychomotor retardation and shrinkage of the brain, caused by a vitamin B₁₂ deficiency.²² Careful planning of the diet is, therefore, of utmost importance. When eggs, meat and dairy products are consumed, women can be ensured of sufficient vitamin B₁₂, calcium, vitamin D, iron, zinc and protein intakes.

In general, people following vegan diets, who are concerned about their calcium, omega-3 fatty acids, vitamin B₁₂, zinc, iron, vitamin D and iodine intakes should consider other sources. To ensure optimal intake of calcium, soy milk or fruit juice fortified with calcium can be consumed. Alternatively, large servings of calcium-rich vegetables such as broccoli and turnip greens, as well as black-eyed peas, can be eaten. Compared with meat, vegetarian sources of iron and zinc, such as legumes, dark green, leafy vegetables, fortified cereals and whole grain breads and cereals provide fewer of these minerals and in a less absorbable form.²³ As the high intake of vitamin C that is often related to vegetarian diets increases the absorption of iron, vegetarian diets may be adequate to a great extent in this respect.²⁴ For vegetarians to obtain enough iron and zinc, an emphasis on whole grains and legumes in the diet is important. A strict vegetarian diet cannot meet vitamin D needs; therefore, supplementation or adequate exposure to sunlight (10 - 15 minutes daily) is essential.²⁵ Eggs, for those who eat them, can help to meet vitamin B₁₂ needs. Vegans should choose vitamin B₁₂-enriched cereals and other sources rich in this vitamin. Fermented plant products may contain some vitamin B₁₂, contributed by the bacteria responsible for fermenting. Much of the vitamin B₁₂ in these foods may,

however, be inactive.¹⁶ Iodine needs can be met by ingesting iodised salt.¹⁶

One must remember that a diet that is not well-planned, whether vegetarian or non-vegetarian, can pose a threat to health. A vegetarian who dines on cheddar cheese, butter sauces, sour cream and deep-fried vegetables invites the same health hazards as a person on a high-fat meat diet. Therefore, whatever a person's preference, the diet should be adequate, balanced, varied and low in saturated fat.¹⁶

The guideline 'Meat, fish, chicken, milk and eggs can be eaten every day', was formulated to convey the message that it is possible to eat a balanced diet without these foods, as many vegetarians do, but that including these foods in the diet will help to meet nutrient needs. The different foods from animals will now be discussed in more detail.

DAIRY AND DAIRY PRODUCTS

South African production and consumption of dairy products

Although the South African dairy industry is the fourth-largest agricultural industry in the country, it is one of the most deregulated dairy industries in the world. It is therefore a price-taker in the international market. This is due to the fact that South Africa has no statutory marketing arrangements, no domestic support and no export subsidies. The industry is thus only protected by import tariffs. South Africa's cow milk production accounts for only 0.4% of the total world production. South Africa does, however, normally produce enough milk to supply the domestic demand for dairy products. Only small quantities of demineralised whey powder and certain exotic types of cheeses are not produced. Some manufacturers import demineralised whey powder to make baby food.²⁶ Dairy products are therefore relatively expensive in South Africa and consumption patterns can be expected to be influenced by price.

In addition to availability and affordability, culture, tradition and religion influence the consumption of dairy products by many South Africans. Most white and coloured South Africans have no cultural, religious or traditional patterns that influence consumption. Many Hindus 'fast' one day a week, a period during which no pulses, cereals or legumes are eaten, but milk, root vegetables and fruit are allowed.³ Black South Africans usually consume sour milk or add it to porridge. Milk has always been a favourite food among blacks. However, numerous taboos and rituals influenced its consumption in the past. Only small children and the elderly drank fresh milk. A man could only drink milk in his own household or in that of a paternal or maternal relative. A woman could only drink milk obtained from her husband's herd and then only when she was accepted by her new family. An 'impure' woman, during menstruation or after a miscarriage, had to avoid milk and all

milk containers. It is not known if these taboos are still practised and if they are responsible for the low milk intake of present day Africans.³

In 1988, Langenhoven *et al.*²⁷ showed that mean intakes from the milk group among coloureds, whites and Xhosa were lower than recommended intakes. Consequently, less than 75% of the recommended dietary allowances (RDAs) for calcium and riboflavin were consumed. If a diet does not include 2 - 3 servings of dairy products per day, the risk for deficient intakes of vitamin D, calcium, magnesium and possibly zinc and iron increases.²⁸ McLaren²⁹ and Garry *et al.*³⁰ suggest that if more than 20% of a population consume less than 75% of the recommended dietary intake for a specific nutrient, then that nutrient deserves attention in that population.

Almost 10 years later, Langenhoven *et al.*³¹ showed in a random sample of 2 000 South African households, that only 13% of the respondents (7% Asians and Africans, 19% coloureds and 23% whites) reported taking more than 400 ml milk per day. Half of the respondents reported that they consumed less than 200 ml per day. In the BRISK study, Bourne and co-workers³² found that among urban Africans in the Cape Peninsula, 58% of the sample of subjects aged 15 - 64 years consumed products from the milk group. The men consumed 0.9 (standard deviation (SD) 1.4) portions per day while women had a mean intake of 0.5 (SD 0.8) per day. In the THUSAstudy, MacIntyre³³ found that in the diet of Tswana-speaking men and women in the North West Province, also aged 15 - 64 years, milk was third on the list of foods consumed in the largest amounts per person per day with only maize products and tea consumed in larger quantities. Mean intakes ranged from 133 g (in men living in informal housing areas) to 375 g (in women living on farms). It is therefore evident that milk is consumed by many South Africans, but that amounts taken are less than what certain sources would regard as recommended intakes (at least 400 ml per day),³⁴ possibly because of its relatively high cost.

These consumption patterns contribute to the low calcium intake reported for South Africans.⁴ The meta-analysis of nutrient intakes of South Africans⁴ showed, for example, that inter-ethnic groups of women aged 25 - 64.9 years had mean intakes of 340 - 917 mg per day, none reaching the reference intake³⁵ of 1 000 mg calcium per day for women in this age group. The question which has to be considered when formulating guidelines for the South African population is whether this intake, which is already considered low when compared with intakes in developed countries, has any detrimental effect on health.

The role of dairy, dairy products and calcium in health

Since separate guidelines will be developed for children under 5 years as well as for pregnant and lactating women, their

needs will not be considered here. Inadequate calcium intake can lead to rickets in children and to osteoporosis and bone fractures in adults.²⁴ Adequate dietary calcium is required to maximise the development of peak bone mass within an individual's genetic potential and to reduce bone resorption in later life.²⁸ In females, less than 90% of total bone mass is achieved by the age of 16.9 years, 95% by 19.8 years and 99% by 26.9 years. Thus, the period for influencing optimisation of peak bone mass declines rapidly after adolescence and the goal thereafter is to reduce bone loss. Aside from hormone replacement therapy in postmenopausal women, diet and exercise are the two most important means of achieving this goal.

Currently it is believed that osteoporosis is not a public health problem in black South Africans compared with the white population.³⁶ However, data from the THUSAstudy³⁷ showed that urban black postmenopausal women were osteopenic, with an increased risk of developing osteoporosis and fractures. It can therefore be expected that in time, with further urbanisation and the nutrition transition, osteoporosis and its consequences could become an increasing health problem.

In addition to its role in protecting the integrity of the skeleton, adequate dietary calcium is also thought to help lower blood pressure, reduce the risk of colon cancer, lessen the symptoms of the premenstrual syndrome, reduce the risk of renal stone formation and possibly protect against obesity.³⁷ However, Heany³⁸ mentions that for optimum benefit, intakes which exceed both prevailing intakes and dietary reference ranges of virtually every industrialised nation are probably necessary. This is a goal which will be difficult, if not impossible to achieve in South Africa. Clearly the optimal intake of dietary calcium to protect South Africans against osteoporosis (not a problem at present in the majority) and hypertension (a major public health problem) as well as the preferred dietary sources of calcium, require more research.

Concerns that dairy products would increase risk of cardiovascular disease by increasing saturated fat intake and serum cholesterol proved to be unfounded.³⁹

St-Onge *et al.*⁴⁰ recently demonstrated that fermented milk consumption actually decreases circulating cholesterol concentrations. Nevertheless, if this is a concern, low-fat or fat free alternatives, which are also good choices to prevent obesity, are readily available.

Lactose maldigestion and intolerance may be a constraint to milk consumption, especially among black South Africans.⁴¹ Studies among rural Zulus demonstrated that > 90% failed to show any change in blood glucose concentrations after the ingestion of 50 g lactose in solution.⁴² Lactose intolerance may primarily develop as a result of lactase deficiency, but also secondarily to an infection of the small intestine or destruction of mucosal cells, e.g. during diarrhoea or AIDS.²⁴ Milk, even in

dried form, may be a versatile supplement to the diet of the malnourished. As most lactose-intolerant adults can consume 6 - 12 g (200 - 240 ml milk) lactose without major symptoms, especially when taken with meals or in the fermented form of yoghurt or *maas* with active cultures,⁴³ the intake of these products is recommended. Dairy products are also good sources of riboflavin and vitamin B₁₂. Furthermore, they are amenable to the addition of other nutrients such as vitamins A and D.

Recommended quantities

Table II shows that 100 ml milk provides about 120 mg calcium. Two cups (400 - 500 ml) will provide 480 - 600 mg or approximately 50 - 60% of the daily calcium reference intake of 1000 mg^{34,44} (in adolescents the reference intake is 1 300 mg). The energy content of 500 ml full-fat milk is 1 310 kJ. The 400 - 500 ml recommended by most sources seems realistic and can be used over porridge, breakfast cereals, with tea and coffee or taken as a drink. Larger quantities could lead to excess energy intake and obesity. If this amount is not affordable, emphasis should be placed on other dietary sources of calcium, such as legumes and bones in tinned fish.

FISH

Consumption patterns

Despite the increasing awareness of the beneficial effects of regular intake of fish, very little is known about consumption patterns of South Africans. In some studies which measured dietary patterns,^{31,32,45} fish was grouped and reported with chicken as 'white meat'. In the THUSAstudy, MacIntyre³³ found that Africans aged 15 - 64.9 years, living in the North West province, consumed only 0.7 - 1.9% of their total energy as fish. In rural areas and on farms, most of the fish eaten consisted of canned pilchards, usually mixed with tomato and onions, often the primary source of protein. In urban areas, home-prepared or commercial fried fish became more popular.³³ It seems as if fish is an acceptable and well-liked food, but that accessibility and price, especially of fresh fish in inland areas, are major constraints for regular consumption.

Health benefits of fish

In addition to its high protein content, fish is an excellent source of several micronutrients (Table II), and especially of calcium if the bones are eaten, as is possible in canned products. But the major contribution of fish, in particular the cold-water marine species such as mackerel and pilchards, to a healthy diet, is long-chain omega-3 fatty acids, eicosapentaenoic acid (EPA, C20:5n-3) and docosahexaenoic acid (DHA, C22:6n-3). The functions and potential beneficial effects of these fatty acids were recently reviewed by Hunter

and Roberts.⁴⁶ They are incorporated into phospholipids of cell membranes, influencing membrane fluidity, receptor-ligand interactions, cell-to-cell interactions, nutrient transport across membranes, neuronal transmission and prostaglandin (local hormones) synthesis. Intervention studies have demonstrated that intake of these fatty acids in the form of fish oil increases HDL₂-cholesterol concentrations, reduces triglyceride concentrations, as well as postprandial lipaemia and chylomicron remnant concentrations, thus decreasing the risk of atherosclerosis and cardiovascular disease.⁴⁷ Other beneficial effects are improved endothelial function and better arterial compliance,⁴⁶ as well as prevention of thrombosis (through effects on platelet aggregation), embolic phenomena, hypertension, auto-immune disease and possible allergic problems.⁴⁸ A significantly reduced risk of thrombotic infarction was found among women who ate fish two or more times per week, primarily among those who do not take aspirin regularly.⁴⁹

Despite these known and demonstrated beneficial effects of EPA and DHA, there has been some controversy in the recent literature⁵⁰ on the protective effect of fish intake against coronary heart disease (CHD). In a systematic review of 11 prospective cohort studies, Marckmann and Grønbaek⁵¹ concluded that fish intake is not associated with reduced CHD mortality in low-risk populations, but that a daily fish consumption of 40 - 60 g is associated with markedly reduced CHD mortality in high-risk populations. Fernandez and co-workers⁵² showed that consumption of even relatively small amounts of fish protects against risk of several cancers, especially of the digestive tract. However, the panel of the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR)⁵³ judged that at present there is insufficient evidence to conclude that fish intake protects against cancer.

Nestel⁴⁷ mentions that there seems to be consensus that eating fish is beneficial at surprisingly modest intakes (two to three fish portions per week). He quotes a report from a study in Tanzania⁵⁴ which showed that eating fish outperformed vegetarianism in risk factor reduction.

EGGS

Consumption patterns of South Africans

Only a few studies in South Africa have attempted to measure egg intake as this is difficult to achieve, because eggs are often used in other dishes and baked products. Langenhoven and co-workers⁴⁵ found that the mean intake of eggs in a coloured community in the Cape Peninsula was 0.4 portions a day, one egg being regarded as a portion. MacIntyre³³ reported that on average, Africans in the North West province consumed between 0.4 and 1.2 eggs per day. The energy provided by eggs was generally more than that provided by chicken or fish,

less than that provided by red meat and similar to the energy provided by legumes.

Eggs and health/ill-health

There is a perception that egg intake raises serum cholesterol concentrations and consequently the risk of CHD. This perception is based on the high cholesterol content of egg yolk (Table II) and metabolic ward studies which showed convincingly that an increased intake of dietary cholesterol usually leads to increased concentrations of serum cholesterol⁵⁵ with concomitant increases in CHD risk.⁵⁶

However, in free-living populations, especially those on Western-type diets, increasing egg intake to two per day, had no effect on blood cholesterol concentrations, nor on other risk factors for CHD.⁵⁷ It is now accepted that dietary cholesterol is the least important of dietary variables influencing blood cholesterol and lipoprotein concentrations in healthy people.⁵⁸ The fatty acid profile of the diet, type of protein (animal v. plant) and dietary fibre are more critical variables. Although eggs are a concentrated source of cholesterol, McNamara⁵⁹ mentions that the mean egg intake of Americans reported in the NHANES II study of 0.64 per day, provided only about a third of the cholesterol in the American diet. Many epidemiological studies (summarised by McNamara⁵⁹) failed to show an association between dietary cholesterol intake and CHD incidence.

The WCRF/AICR panel⁵³ concluded that egg intake may possibly contribute to an increased risk of colon and rectal cancer, but that more research is needed before a judgement can be made.

Recommended egg intake

Eggs are excellent sources of high quality protein and other nutrients. Because they are relatively inexpensive compared with other animal-derived foods, eggs can play a valuable role in balancing diets of undernourished South Africans. Three to four eggs per week should not lead to overconsumption of dietary cholesterol and fat, especially if eggs replace other foods from animals in the diet and if they are cooked and served without added fat.

MEAT (RED MEAT AND CHICKEN)

Consumption patterns of South Africans

A number of studies^{31-33,45} have shown that meat is a favourite and popular food in South Africa. Price is probably one of the main factors limiting intakes, although health recommendations against overconsumption may be starting to play a role in some segments of the population.

Langenhoven *et al.*⁴⁵ showed that 98% of a sample of coloured respondents reported that they consumed foods from

the 'meat' group. A portion or serving was taken as 90 g, and the mean intakes were 1.4 portions of red meat daily and 1.1 portions of chicken and fish. In the BRISK study³² on urban black people from the Cape Peninsula, 88% of the sample consumed foods from the 'meat' group. The CORIS study⁶⁰ indicated that 39% of the total energy intake in white men and 37% in white women came from the 'meat' group, with red meat providing two-thirds of the intake. This means that approximately 25% of total energy intakes came from red meat, which equals the 24% reported for Danes, regarded as the highest in the world.⁵³ In the THUSASTUDY,³³ red meat was among the top ten foods consumed in the largest amounts per person per day, except for respondents living on farms. Its position ranged from sixth to tenth place. This study also showed a marked increase in consumption of red meat with urbanisation of black South Africans, confirming the results of the meta-analysis of nutrient intakes of South Africans,⁴ which showed higher animal protein intakes in urban v. rural groups. With increasing urbanisation and economic development, increased intakes of meat in black South Africans can be expected. This is in contrast to the situation in developed countries, where red meat consumption is decreasing.⁶¹

Red meat and health/ill-health

Intake of red meat is probably associated with an increased risk of colon and rectal cancer.⁵³ This relationship does not seem to be related to the total or saturated fat content of meat⁶² but possibly to the formation of heterocyclic amines during cooking.⁶³ However, the saturated fat content of meat, through its effects on total and LDL cholesterol concentrations, is generally accepted to increase risk of CHD. Breslow and co-workers⁶⁴ used the 1987 National Health Interview Survey data of 20 195 participants to examine the association between diet and lung cancer mortality. They found that intake of red meat was positively and significantly related to lung cancer mortality, while dairy products showed an inverse association. Another potential hazard of meat intake is microbial infection,⁶⁵ emphasising the importance of hygienic handling and proper cooking of meat.

Red meat, when consumed as part of a prudent diet, does not necessarily increase risk of chronic disease. Wolmarans *et al.*⁶⁶ showed that lean beef and mutton did not adversely affect the lipoprotein profiles of hypercholesterolaemic subjects when it was consumed as part of a prudent diet. An Australian study⁶⁷ found that meat consumption was not associated with abnormal blood platelet function.

Recommended meat intake

The seventh guideline of the new South African food-based dietary guidelines recommends that 'fats should be eaten sparingly'. Ways to comply with this guideline are to choose low-fat or lean meats, including game and ostrich, known for

their low-fat content,⁶⁸ and to prepare and cook meat without added fats and oils. This should reduce saturated fat intake and risk of CHD. It would be unwise for nutritionally compromised individuals to avoid meat intake because of its potentially harmful effect on chronic disease. Ortega and co-workers⁶⁹ showed that in Spanish women, those with higher meat intakes (greater than 100 g per day) had better nutritional status and haematological profiles than those who consumed a low-meat diet. Sandstead⁷⁰ concluded in his review that low consumption of foods such as red meat, which are rich in iron and zinc, and high consumption of foods rich in iron and zinc inhibitors (phytate, dietary fibre, calcium) may be contributing factors in causing iron and zinc deficiencies. Neuropsychological impairment is one of several potential outcomes of these deficiencies.

It is evident that meat can contribute to improved nutritional status. The question is how much meat will provide nutritional benefits without increasing risk of cancer. In their summary of the dietary recommendations of the WCRF/AICR,³³ Munoz de Ch'avez and Ch'avez⁷¹ pointed out that not more than 80 g of 'meat' should be eaten daily, preferably poultry or fish. This means that 560 g of meat can be eaten every week without increasing the risk for cancer.

DISCUSSION AND CONCLUSION

As summarised in the National Food Consumption Survey (NFCS),² the consumption of animal products was significantly correlated with stunting and underweight in children aged 1 - 9 years in South Africa. Furthermore, for South African children as a whole,² the dietary intake of several nutrients (calcium, iron, zinc and B vitamins) of which animal products are excellent sources, was less than 67% of the RDAs. The literature quoted in this article aims to emphasise the important nutrient contribution that foods from animals can make to the diet. Clearly these foods help to improve the adequacy of diets and will help consumers to meet their nutrient needs. The literature, however, also showed that overconsumption, especially of high-fat products and red meat, could increase risk of several chronic diseases. It is also pointed out that low-fat alternatives are available for milk and other dairy products, as well as for meat.

It is, therefore, recommended that optimal amounts of these foods should be eaten where possible and economically feasible. This would include the following:

- 400 - 500 ml milk or equivalent daily, preferably as low-fat products; low-fat or fat-free/skim milk are economical options. Milk will become more affordable if meat intake is reduced. If milk is not included in the diet, other sources of dietary calcium such as legumes and tinned fish should be emphasised.
- two to three fish dishes per week, preferably dark fatty

marine fish such as mackerel or pilchards (tinned products are economical and healthy options)

- about four eggs per week, preferably to replace the 'meat' serving (red meat, chicken)
- not more than 560 g red meat per week (approximately 80 - 90 g per day), preferably low-fat types and cuts, and cooking methods are preferable options.

The dietary patterns and nutrient intakes of black South Africans are in a process of transition as a consequence of urbanisation, acculturation and economic development. This transition is characterised by increased intakes of foods from animals among certain subgroups, but also by increased intakes of fruits and vegetables, leading to more adequate diets.³³ The diets of other South African groups (whites, coloureds and Asians) are characterised by high intakes of meat, total fat, and not sufficient dietary fibre.³⁴ As reflected in the recommendations made in the NFCS,² the need for improvement in education on social awareness of nutrient needs is still of great concern overall, but especially among mothers and caregivers, as younger children (1 - 3 years of age) are considered a prime target group for intensified nutritional intervention.

The challenge is thus to aim for 'optimal' diets and nutrient intakes of all South Africans, which should be both adequate and prudent. Foods from animals can play an important role in reaching this goal if they are eaten in the amounts recommended above. Because many South Africans are eating too much meat already, it would need a huge consumer education effort to accomplish this. It is important to acknowledge that vegetarian diets can be adequate, generally more economical, and associated with less risk of chronic non-communicable disease, but they need to be well planned to be sufficient in all the important nutrients. The 'ideal' diet would probably be a plant-based one, with additions of foods from animals to increase variety and to ensure optimal nutrient intakes.

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EAT FATS SPARINGLY — IMPLICATIONS FOR HEALTH AND DISEASE

P Wolmarans, W Oosthuizen

Objective. To assess the scientific merit and feasibility of the food-based dietary guideline to 'eat fats sparingly'.

Scientific background. Recent evidence from the literature has shown that increased fat intake, especially intake of saturated fatty acids (SFAs), is positively associated with cardiovascular disease, obesity and certain types of cancer such as breast, colon and prostate cancer. The prevalence of these chronic diseases is high in South Africans. Many South Africans follow diets high in fat and SFAs, mainly provided by meat and meat products. The high consumption of hydrogenated fats, high in *trans* fatty acids, by a majority of South Africans is also a major concern. A very low-fat diet may have adverse effects on health. A moderate-fat diet, providing less than 30% of total energy, is therefore recommended. Foods contributing to fat intake and recommendations on how to control fat intake in diets of South Africans are discussed.

Conclusions. The guideline, 'eat fats sparingly' embodies the recommendation that fat should be eaten (addressing undernutrition), but that it should be used sparingly (addressing overnutrition).

For the prevention of chronic diseases of lifestyle South Africans should be encouraged to lower their fat intake from animal sources and non-dairy creamers, and to consume unsaturated tub margarine and oils instead of hydrogenated fats and animal fats. Fat in food preparation and as bread spread should be used sparingly.

In conclusion, there is convincing scientific evidence to support the guideline for fat intake. It is practical, realistic, culturally sensitive and sustainable, and in combination with the other food-based guidelines will contribute to better nutrition among South Africans.

The guideline, 'eat fats sparingly', aims to lower fat intakes, especially intake of saturated fatty acids (SFAs), among those who follow a typical Western diet high in fat, and to control fat intake in those following a diet low in fat. To meet the objective of the first part it is necessary to decrease the total intake of

foods from animal sources and to make lower fat choices when eating foods of animal origin.

Dietary fat plays an important role in the health and functioning of the human body but overconsumption is linked with coronary heart disease (CHD), obesity and cancers such as breast, colon and prostate cancer.^{1,3} The guideline to 'eat fats sparingly' is therefore primarily aimed at lowering the prevalence of these chronic diseases of lifestyle among South Africans. Cross-sectional studies^{4,6} have shown a high prevalence of overweight and obesity among South Africans and the majority of these studies have indicated a fat intake of more than 30% of energy. South Africans with a high prevalence of CHD⁷ also follow high-fat diets.⁸ CHD prevalence among black South Africans is still low;⁹ this may be partly ascribed to their diet which is still low in fat.⁸ However, Bourne and Steyn¹⁰ have shown that increased urban exposure has resulted in an increased intake of fat, from 15% energy in 1940 to about 30% energy in 1990. Continued urbanisation may therefore lead to an increase in the development of chronic diseases of lifestyle in those presently following low-fat diets.

In this paper the scientific evidence to support the guideline to 'eat fats sparingly' will be reviewed, the possible nutritional consequences and health implications of implementing the guideline will be discussed, and practical recommendations based on current food patterns will be given. Because this subject has been reviewed extensively by several authors, information from review articles is used in many instances.

GENERAL FUNCTIONS OF DIETARY FAT AND RECOMMENDED INTAKES

Dietary fats are classically defined as triglycerides (fats and oils), phospholipids and sterols (cholesterol). According to the degree of saturation, fatty acids can be classified as saturated (SFAs) from animal origin and β -sitosterol, campesterol and stigmasterol from plants, and monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids. PUFAs are further classified into omega 6 (n-6) and omega 3 (n-3) fatty acids.¹¹

Dietary fats provide the body with a continuous fuel supply, keep it warm, and protect it from mechanical shock. The human body can synthesise all but two fatty acids — the PUFAs, linoleic and alpha-linolenic acids, termed essential fatty acids (EFAs). These fatty acids are precursors for eicosanoids (hormone-like substances) that help regulate blood pressure, heart rate, blood clot formation, blood lipids and the immune response. They are also essential in the growth and development of infants. Docosahexaenoic acid (DHA), a derivative of linolenic acid, plays a major role in retinal function and brain development. In food, dietary fat is also a carrier of the fat-soluble vitamins A, D, E and K and many other compounds that give foods their flavour, tenderness and palatability.¹¹

The phospholipids and cholesterol contribute to the structure of cell membranes. Cholesterol is also used as a substrate for sex hormones (oestrogens, testosterone and progesterone), bile acids, and vitamin D, and it is a major component of brain and nerve cells.¹⁰

Dietary fat therefore plays a critical role in the health and functioning of the human body. Overconsumption of dietary fat has, however, been implicated in the aetiology of cardiovascular disease (CVD), certain types of cancer and obesity.¹¹ These detrimental effects of dietary fat led to the formulation of the dietary guideline proposed by many national and international scientific bodies, namely that intake of dietary fat should be less than 30% of total energy (%E) for individuals over the age of 2 years.¹² Further dietary recommendations for fat intake in adults, specifically to reduce the risk of chronic diseases, suggest SFAs of < 10%E, MUFAs of > 10%E, PUFAs of < 10%E and dietary cholesterol of < 300 mg/day.¹³ At least 15%E should come from fat, while women of reproductive age need at least 20%E from fat.¹⁴ Children up to the age of 2 years need 30 - 40%E from fat.¹⁵ At least 1 - 3%E should be contributed by linoleic acid,¹⁶ but desirable levels are between 4 and 10% of energy.¹⁷ In adults the requirement for linoleic acid will be met by the inclusion of 15 g of sunflower oil or 20 g of margarine high in PUFAs. It is recommended that the ratio of linoleic acid to alpha-linolenic acid should be between 5:1 and 10:1.¹⁸

FAT INTAKE OF SOUTH AFRICANS

A review of the nutritional status of South Africans from 1975 to 1996¹⁹ showed that total fat intake (Fig. 1) in white, coloured and Indian South Africans exceeded the recommended 30%E. While rural blacks had low fat intakes, urban blacks were found to be following diets much higher in fat than the rural diet, although less than 30%E. Eleven to 16-year-old boys and girls of all ethnic groups were noted to be following diets in which fat contributed 30%E or more. Intake of SFAs by white,

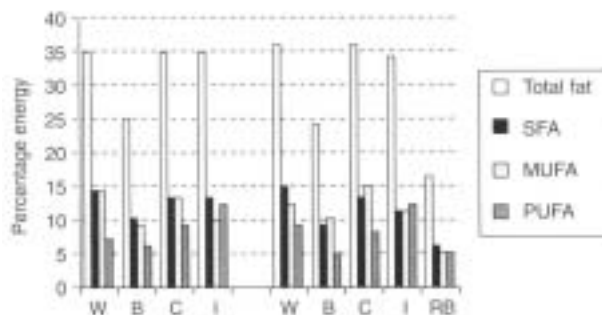


Fig. 1. Percentage of total energy provided by fat intake in the diets of adult South Africans aged 25 - 65 years* (W = whites; B = blacks; C = coloureds; I = Indians; RB = rural blacks; SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids).

coloured and Indian South Africans was high and PUFA and MUFA intakes of white and coloured South Africans were in accordance with the recommendations. The Indian diet provided too much PUFA at the expense of MUFA intake, indicating the liberal use of PUFA-rich plant oils in cooking of food.

A meta-analysis of cholesterol intakes by South Africans, measured using the 24-hour recall method, showed that except for white and coloured adult men, all groups had cholesterol intakes that fell within the dietary guidelines.²⁰ Studies that used other dietary intake methods found high intakes among Indian and coloured men and white and coloured women.²¹

FAT INTAKE AND CHRONIC DISEASE

Coronary heart disease (CHD)

CHD is one of the leading causes of mortality and morbidity in South Africa.²² CHD mortality rates are highest among Asians, whites and coloureds.²³

Total fat intake

A meta-analysis by Hooper *et al.*²⁴ of randomised controlled intervention trials of at least 6 months' duration showed that a reduction or modification (where a proportion of saturated fat is replaced with unsaturated fats) of dietary fat intake reduced the incidence of cardiovascular events. The protective effect was seen almost exclusively in those who continued to modify their diet over a period of at least 2 years.

Most of the studies²⁵ that examined the effect of dietary fat intake and prevention of CHD focused primarily on fat intake and blood lipid levels. Elevated serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG) and decreased high-density lipoprotein cholesterol (HDL-C) levels are well-recognised risk factors for CHD.²⁶

In South Africa four large epidemiological studies were undertaken to study the relationship between dietary intake and risk factors for CHD. These studies were the Risk Factors for Coronary Heart Disease in the Black Population of the Cape Peninsula (BRISK) study,²⁷ the study of Indian South Africans,²⁸ the Coronary Risk Factors in the Coloured population of the Cape Peninsula (CRISIC) study of South Africans of African-European-Malay descent,²⁹ and the Coronary Risk Factor Intervention Study (CORIS) of white South Africans.³⁰ These studies showed that increased fat intake was associated with increased serum cholesterol levels (Fig. 2). Only black South Africans were found to be consuming diets with a fat content of less than 30%E and they were also found to have low serum cholesterol levels.³¹

Different levels of total fat intake in the diet may have different effects on lipid levels. A very low-fat diet, where fat is replaced with carbohydrates, reduces LDL-C but in addition

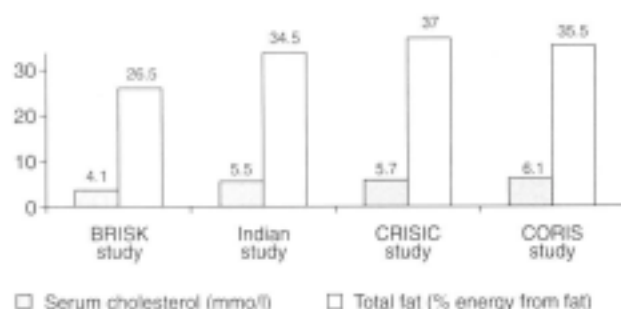


Fig. 2. Mean fat intake and mean serum cholesterol levels of participants in four large epidemiological studies conducted in South Africa (BRISK study,¹ Indian study,² CRISIC study,³ CORIS study⁴).

also reduces HDL-C, increases TG levels and small density LDL particles. This pattern is called the atherogenic lipoprotein phenotype and raises the risk for CHD.¹⁰ When very low-density lipoprotein (VLDL) concentrations are elevated TGs are transferred from VLDL to LDL and HDL particles in exchange for cholesteryl esters. TGs transferred to LDL and HDL are susceptible to hydrolysis by hepatic lipase which reduces the size of these lipoproteins resulting in more atherogenic LDL particles and reduced HDL particles.¹⁰ Table I summarises the physiological and biochemical effects of different levels of fat intake on health outcomes.¹¹

Compared with a low-fat diet, a moderate-fat diet (30%E), low in SFAs (< 10%E) and high in either MUFA or PUFA only lowered LDL-C levels and in some instances also increased

HDL-C levels.¹¹ A moderate-fat diet may not only have biochemical advantages over a very low-fat diet, but may be more palatable and may thereby increase compliance.

High-fat diets increase LDL-C and TG levels as well as HDL-C levels.¹¹

The effects on lipid levels differ with the different classes of fatty acids in the diet. The balance between these fatty acids is therefore important.

Type of fat in the diet

Table II summarises the effects of the different classes of fatty acids in food on the lipid profiles of humans. The fatty acid content of some fats and oils are summarised in Fig. 3.

SFAs: The SFAs with lauric (C12:0), myristic (C14:0) and palmitic (C16:0) acids are hypercholesterolaemic, whereas stearic acid (C18:0) has little effect on cholesterol levels.¹² The conversion of stearic acid to oleic acid (C18:1) could explain why stearic acid does not increase plasma cholesterol levels.¹² Dietary sources of these cholesterol-raising fatty acids include animal products (such as butter, beef tallow, mutton, lard and chicken), and vegetable fats (such as coconut oil, palm kernel oil and palm oil) (Fig. 3), coffee creamers and dairy blends. Palm oil has, however, been shown in some studies to have a neutral and even cholesterol-lowering effect, probably because of its high tocotrienol and oleic acid content.¹³

Trans fatty acids: Several epidemiological investigations indicated that trans fatty acids, found in hydrogenated brick

Table I. Different levels of total fat intake and the effects on physiological and biochemical variables and possible health outcomes/risk¹¹

Level of fat intake	Physiological/biochemical effects	Health outcomes/risk
Low-fat diet (10%E)	↓LDL-C; ↓HDL-C; ↑TG Insulin resistance (glucose intolerance)	Delays development of atherosclerosis ↓CHD Atherogenic lipoprotein phenotype* Hypertension Diabetes mellitus ↓Cancer risk
Moderate-fat diet (30%E, low in SFA < 10%, MUFA/PUFA instead of SFA)	↓LDL-C, ↑HDL-C, ↓TG Lower body mass	Delays development of atherosclerosis ↓CHD ↓Cancer ↓Diabetes mellitus ↓Hypertension
High-fat diet (> 30%E)	↑LDL-C, ↑HDL-C, ↑TG Overweight and obesity	Atherosclerosis CHD Hypertension Some types of cancer (e.g. colon, breast and prostate cancer) Diabetes mellitus Insulin resistance syndrome (Syndrome X)

* Atherogenic lipoprotein phenotype: ↓HDL-C, ↑TG, small LDL particles.

LDL-C - low-density lipoprotein cholesterol; HDL-C - high-density lipoprotein cholesterol; TG - triglycerides; CHD - coronary heart disease; SFA - saturated fatty acid; MUFA - monounsaturated fatty acid; PUFA - polyunsaturated fatty acid.

Table II. Effects of the different classes of fatty acids on lipid profiles^a

Fatty acids	TC	LDL-C	HDL-C	TG
Saturated fatty acids	↑↑↑	↑↑	↑	↑
Trans fatty acids	↑↑	↑	↓	↑
Monounsaturated fatty acids	↓	↓	↑	↓
Polyunsaturated fatty acids	↓↓	↓	↓	↓

TC = total cholesterol; LDL-C = low-density lipoprotein cholesterol; HDL-C = high-density lipoprotein cholesterol; TG = triglycerides.

margarine and hydrogenated plant and fish oils used in commercial food processing, may increase the risk for CHD.¹⁰ Although to a lesser extent than SFAs, *trans* fatty acids raise TC, LDL-C and TG levels and decrease HDL-C levels.¹¹ *Trans* fatty acids are also one of the rare dietary factors that may increase lipoprotein (a) (Lp(a)) levels, although this is not a consistent finding.¹² It may be useful to consider the sum of SFAs and *trans* fatty acids in evaluating the health effect of fats and oils.¹³

MUFA and PUFA: MUFA has a neutral effect on TC and LDL-C concentrations when compared with carbohydrate, and a cholesterol-lowering effect when compared with SFAs. In some studies MUFA and PUFA seem to be equally effective in lowering TC and LDL-C levels, whereas in other studies MUFA was found to be less effective than PUFA.¹⁴ MUFAs, like SFAs, raise HDL-C and are not as easily oxidised as PUFAs.¹⁵ Calculations from a meta-analysis of 27 studies showed that isocaloric replacement of SFAs in the diet with PUFAs would result in a statistically, but perhaps not biologically, significant decrease in HDL-C levels.¹⁶ There are, however, indications that PUFA does not lower HDL-C if the intakes are less than 10 - 13%E.¹⁷ Lower TG levels were observed on a high-fat high MUFA diet compared with a low-fat high carbohydrate diet.¹⁸ Oleic acid (C18:1n-9) is the best known MUFA. Although all foods contain MUFA, rich sources of oleic acid are olive and canola oils (Fig. 3). Avocados and nuts also have high MUFA contents.

PUFAs can be divided into n-6 and n-3 PUFAs. Linoleic acid (C18:2n-6) is the parent fatty acid of the n-6 PUFAs and alpha-linolenic acid (C18:3n-3) of the n-3 PUFAs. Vegetable oils such as sunflower, corn and safflower oils are rich sources of the n-6 PUFAs (Fig. 3). In the Western diet the n-3 PUFAs mainly come from fatty fish (such as mackerel, pilchards, salmon, herring and sardines) and plant oils such as canola and soybean oil (Fig. 3). Flaxseed oil has a high n-3 PUFA content,¹⁹ but it is not commonly used in South Africa (Fig. 3). The role of the n-6 and n-3 PUFAs in the prevention of CHD has been investigated for several decades.²⁰ While the main effects of n-6 PUFAs are anti-atherogenic, those of the n-3 PUFAs are antithrombotic because they inhibit platelet aggregation.²¹ A salient but consistent characteristic of n-3 PUFAs is also to lower TG levels in normo- as well as hyperlipidaemic subjects.²² Although high intakes of

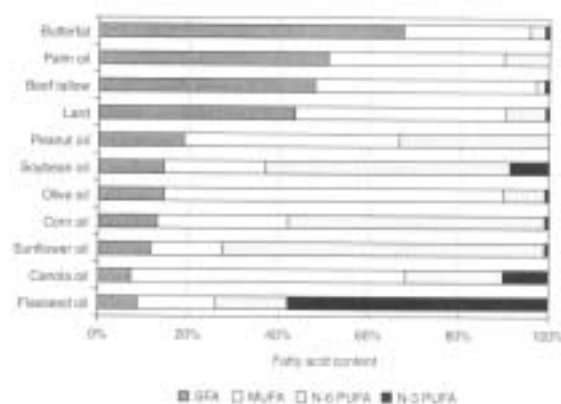


Fig. 3. Fatty acid content of some fats and oils (adapted from Vaisey-Genser and Morris²³) (SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids).

n-3 PUFAs also lower LDL-C, a tendency of n-3 PUFAs to increase LDL-C in hyperlipidaemic patients has been observed.²⁴

Since there is at present no country with traditionally very high PUFA intakes, only time will tell whether a high intake of PUFA has health implications.²⁵ There are concerns that a high intake of PUFAs may promote cancer or lead to the oxidative modification of lipoproteins that probably play a role in atherosclerosis.²⁶ Oxidation of PUFAs may be prevented with a vitamin E-to-PUFA ratio of > 0.6 mg tocopherol equivalents per gram of PUFA.²⁷

Cholesterol intake can also increase TC and LDL-C levels in the serum of susceptible individuals, but the response is less than that induced by changes in the fatty acid composition of the diet.²⁸

Obesity

Obesity (body mass index > 30 kg/m²) is common among South African women. The highest prevalence of 59.4% was observed among black women aged 45 - 54 years.²⁹ Coloured women of the same age have a prevalence of 42.6%, Indian women of 40% and white women of 23.8%.³⁰ The prevalence of obesity may rise even further with continued urbanisation. Other chronic diseases associated with obesity, namely hypertension and diabetes mellitus, are also major public health problems in South Africa.³¹

Although the evidence from ecological studies is less convincing, most cross-sectional studies, and experimental studies on animals and humans have shown a positive association between the percentage of energy consumed from fat, and obesity.³² Obesity is, however, a multifactorial condition and although dietary fat plays an important role in its aetiology, it is probably not the primary cause.³³ Decreased physical activity also plays a very important role in the causation of obesity.³⁴

Dietary fat may contribute to obesity through several mechanisms. Firstly, obesity is ultimately an issue of positive energy imbalance.¹² Dietary fat may contribute to this imbalance because of its high energy density.¹² Secondly, fat ingestion is subjectively less satiating than carbohydrate and therefore could promote overeating. Obese persons also prefer high-fat foods and therefore overeat. Thirdly, excess dietary fat does not acutely increase fat oxidation as does carbohydrate and protein. The capacity for fat storage in adipose tissue in the body is virtually unlimited and very efficient.³⁸ Obese individuals may also be more susceptible to dietary fat because of defects in the ability to oxidise dietary fat.^{12,39}

A very low-fat diet, high in carbohydrate, will, however, not necessarily prevent the development of obesity^{36,37} and may even have other adverse effects (Table I). A study of Finnish children suggested that fat restriction may suppress height velocity.⁴⁰ The question of at what age to introduce the guideline to 'eat fats sparingly' is therefore very important in South Africa where the prevalence of stunting is high in certain communities, especially those known to follow a diet low in fat.⁸

A moderate-fat diet in combination with the other guidelines, especially to 'be active', is therefore recommended for the treatment and prevention of obesity.

Cancer

Ecological data suggest that cancer risk is lower in populations with a fat intake of less than 30%E.³

Reports published by authoritative sources in the USA and by the World Health Organisation have concluded that dietary fat may influence the risk of certain types of cancer such as breast, colon and prostate cancer.³ The findings from these reports were consistent and were supported by findings of other studies not included in the abovementioned reports.³ To use controlled trials for the investigation of a relationship between fat intake and cancer is problematic. Therefore, the findings of a relationship between fat intake and cancer is primarily based on observational studies and supported by studies done on animals.³ It has therefore been recommended that health claims about fat and cancer should not be site-

specific, and that fat intake should thus not be linked with specific cancers.³

Very few studies have examined the effect of different types of fat on cancer risk and the results have been controversial. Meta-analyses of case-controlled and cohort studies have shown a positive association between SFA intake or intake of foods high in SFAs (meat, milk, cheese) and breast cancer.¹² Ecological studies have shown protective effects against colon cancer in populations consuming high-fat diets containing olive or fish oils compared with the promoting effect of animal fat.¹² Results from the EURAMIC study⁴¹ showed an inverse association between increased n-3 to n-6 fatty acid ratio and breast cancer.

Questions arise regarding whether the relationship between fat intake and cancer is a direct relationship or whether cancer is caused by a higher intake of energy, and obesity, which is usually associated with a higher fat intake. Cancer development is probably influenced by both.⁴² Results from the prospective Nurses' Health Survey, which studied women between 34 and 59 years of age, showed a positive association between fat intake and the risk of colon cancer after adjustment for energy intake.⁴³

FOODS THAT CONTRIBUTE TO FAT INTAKE IN SOUTH AFRICAN DIETS AND PRACTICAL RECOMMENDATIONS

The large epidemiological studies undertaken in South Africa found that the meat group (red meat, chicken, fish and meat products) was the main contributor of fat in the diet, followed by the fat group (butter, margarine, animal fat and oil).⁴⁴⁻⁴⁶ Unfortunately the South African Food Composition Database does not allow for separate analysis of fat used in food preparation. Therefore the possibility exists that the contribution of fats and oils to total fat intake could have been higher than reported in these studies.

The percentage of South Africans consuming food items contributing to fat intake, which fell within the top 10 foods consumed by participants in the CORIS (whites), CRISIC (coloureds)²¹ and BRISK (blacks)¹⁹ studies, is summarised in Table III. The foods were ranked in order of the percentage of

Table III. Foods, contributing to fat intake, which fell in the top ten foods eaten by most South Africans and the percentage of adults who consumed the foods (P Wolmarans — unpublished data)

CORIS (1983)* (N = 1 784)			CRISIC (1982)* (N = 976)			BRISK (1990)* (N = 983)		
Rank order	Food item	Consumers (%)	Rank order	Food item	Consumers (%)	Rank order	Food item	Consumers (%)
3	Milk — full-cream	78	3	Margarine — brick	64	3	Milk — full-cream	45
6	Margarine — brick	61	6	Milk — full-cream	57	8	Margarine-brick	40
7	Mutton	50	10	Beef/chicken	28			

*Dietary data collected by 24-hour recall.

subjects who consumed a specific food item on the day the 24-hour recall was done (P Wolmarans — unpublished data). Full-cream milk and brick margarine were among the top 10 foods in all the studies. There is, however, a marked difference between the studies with regard to the percentage of respondents who consumed these foods, for instance only 45% of blacks (BRISK study) consumed full-cream milk. Only in the white (CORIS study) and coloured (CRISIC study) groups did meat fall within the top 10 foods. Correspondingly, the total fat intake in these subjects^{21,22} was high compared with the intake of participants in the BRISK study.¹⁹

Milk intake

South Africans prefer full-cream milk (Table III). A national cross-sectional questionnaire survey undertaken in 1991 and involving 2 000 South Africans over 18 years old, showed that white and coloured South Africans consume more milk than their black and Indian South African counterparts.⁴⁷ This difference in dietary pattern needs to be taken into account when South Africans are advised to make lower fat dairy choices. There is a tendency to exclude milk from the diet when people are advised to make lower fat dairy choices and this should be avoided because there are already indications that South Africans do not consume enough milk.⁴⁷ Non-dairy creamers which are high in fat are often consumed instead of milk. A study of 11-year-old children showed that 6 - 18% of urban and 4 - 25% of rural children used non-dairy creamers.⁴⁸ Additional information supporting this guideline for fat intake should therefore advise against the use of non-dairy creamers as a substitute for milk intake, not only because this practice contributes to total fat intake, but also because these products contain plant oils high in cholesterol-raising SFAs.

Intake of fat spreads and oils

Table III shows that brick margarine, which has a high *trans* fatty acid content, is preferred by most South Africans. The national cross-sectional survey also showed that the majority of participants consumed brick margarine, with as many as 71% of coloured South Africans indicating that they used brick margarine.⁴⁷ Tub margarine was used by between 16 and 37% of South Africans who participated in this survey. In the Indian diet vegetables and other foods are often fried in fats and oils, especially vegetable oils, resulting in a high-fat diet with a PUFA/SFA ratio of 0.9 to 1.0.⁸ The guideline to 'eat fats sparingly' should therefore not only encourage those who consume a lot of fat and oils to eat less fat, it should also encourage the choice and consumption of unsaturated tub margarine and oils instead of hydrogenated fats and animal fats.

Meat intake

The meat group, which included red meat, chicken, fish and meat products, was found to be the main contributor of energy

and fat in the diets of the CORIS and CRISIC study populations.^{45,46} Although meat did not fall within the top 10 foods eaten by the BRISK population, it was the main contributor of fat to the diet.⁴⁴ Mutton, chicken, beef, fish and sausage appear in the top 20 list of foods consumed by the CORIS population, while fish, beef, chicken and mutton appeared in the list of the CRISIC population. In the BRISK study only chicken appeared in the top 20 list of foods eaten by this study population. This could explain, in part, the Western-type diet followed by white and coloured South Africans^{21,22} since the meat group is an important source of fat and SFAs in the diet. As shown earlier, white, coloured and Indian South Africans also had the highest intakes of SFAs (Fig. 1). The guideline to 'eat fats sparingly' will be especially applicable to South Africans with a preference for meat.^{44,46} Cutting down on the intake of visible fat from this component of the diet will make a major contribution to lowering total fat intake.

IMPACT ON OTHER NUTRIENTS OR FOOD PATTERNS AND HEALTH OUTCOMES

The current review shows that a balance between fat intake and other nutrients, especially carbohydrate intake, is important to ensure optimal nutrition and health. The lowering of fat in the diet may result in a shift towards a higher intake of carbohydrates and also result in a lower intake of fat-soluble vitamins. The higher intake of carbohydrates may affect insulin metabolism, raise TG and lower HDL-C levels (Table I).^{12,24} The lowering of fat intake may also not be sufficient to prevent obesity.^{36,37} These concerns may be addressed by eating a moderate-fat diet instead of a low-fat diet and by implementing the other dietary guidelines such as: (i) be active; (ii) make starchy foods the basis of most meals; (iii) eat plenty of vegetables and fruits; and (iv) eat dry beans, peas, lentils and soya regularly. These guidelines will assist in the prevention of obesity and will result in higher intakes of dietary fibre that will counteract the negative effects on insulin resistance, TG and HDL-C²⁵ and prevent decreased intakes of some vitamins.

SUMMARY AND CONCLUSION

There is enough evidence from the literature to conclude that dietary fat plays a role in the development of CHD, obesity and cancer. The guideline to 'eat fats sparingly' is therefore based on sound scientific knowledge. The literature also clearly indicates that, especially in terms of the development of CHD, the type of fat eaten plays an important role. Not only should those South Africans who consume a high-fat diet be encouraged to lower their fat intake, but they should also be encouraged to make the right choices in terms of the type of fat they consume. A moderate-fat diet with a low SFA and high MUFA content was found to have the most beneficial effect on lipid profiles. South Africans who followed a Western diet had a high intake of SFAs, probably related to their high intake of

What does it mean in practice to 'eat fats sparingly'?

Only small changes in food intake are required to meet the 'eat fats sparingly' guideline. The following can serve as an example. Say the energy intake of a person is 8 000 kJ/day and 37% of energy comes from fat, this means a fat intake of 80 g/day. To lower fat intake to 30% of energy, this person needs to lower fat intake to 65 g/day, thus fat intake needs to be lowered by 15 g. About 3 teaspoons (15 ml) of fat or oil contain 15 g fat.

Note: 1 gram of fat = 37 kJ.

The following foods serve as examples of how fat intake can be decreased by following the guideline 'eat fats sparingly':

Choose	Fat (g) ⁴⁹	Instead of	Save	
			Fat (g) ⁴⁹	Fat (g)
250 ml low-fat milk*	4.8	250 ml full-cream milk	8.3	3.5
100 g lean beef [†]	7.5	100 g beef with fat	15.3	7.8
1 medium boiled potato [‡]	0.1	1 medium potato, chips, fried	16.1	16.0
Margarine, thinly spread (5 g) [§]	4.1	Margarine, thickly spread (10 g)	8.2	4.1
1 medium apple (150 g) [¶]	0.5	2 commercial cookies (20 g)	2.7	2.2

*Lower fat food choices.

[†]Remove visible fat.

[‡]Use less fat in food preparation.

[§]Use less fat on bread.

[¶]Eat fruit instead of snack foods with fat.

meat. They should be encouraged to reduce the intake of meat and visible fat from meat. MUFA intakes of > 10%E have been reported for those following a Western diet, but Indian South Africans had higher PUFA intakes at the expense of MUFA intake. Oils with a high MUFA content are expensive in South Africa and are at present not a practical option when it comes to the recommendation to increase MUFA intake. The fat intake of the black population is still prudent, but continued urbanisation might cause increased fat intake in future. The high intake of hydrogenated fats and oils, high in *trans* fatty acids, by the majority of South Africans in the form of bread spread and in food preparation is also of concern. South Africans should be advised to use unsaturated tub margarines and oils instead. The guideline to 'eat fats sparingly' does not address the question of the type of fat in the diet properly, but by lowering the total fat intake, SFAs and *trans* fatty acids intake will probably also be lowered.

Eating fats sparingly does not mean a no-fat diet. From the current review it was clear that a very low-fat diet has other adverse effects. In addition to contributing to undernutrition and stunted growth in infants and children it could also result in the atherogenic lipoprotein phenotype, increasing the risk for CHD in adults. The very low-fat diet consumed by South Africans living in rural areas had probably contributed to the high prevalence of stunting in children. Terms such as 'limit' and 'avoid' were not used in the guideline. The recommendation is that fat should be eaten, but that it should be eaten sparingly.

In conclusion, there is convincing evidence to support this guideline. It is practical, realistic, and its application can be potentially culturally sensitive and sustainable because of the variety of food choices that can be made to either increase or decrease fat intake. In combination with the other guidelines, it will contribute to improved nutrition among South Africans.

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EAT SALT SPARINGLY — SPRINKLE, DON'T SHAKE!

K E Charlton, P L Jooste

The salt-blood pressure hypothesis states that an excessive salt intake leads to an increase in blood pressure in genetically susceptible persons and, if high intake is maintained long term, ultimately leads to sustained hypertension. It is estimated that about 3.3 million South Africans (12.6% and 16.3% of adult men and women, respectively) are hypertensive. However, not all subjects within a particular population respond equally to exposure to high-salt diets. Methods to identify those who are 'salt sensitive' remain in the research domain; therefore a population approach to the restriction of dietary salt intake is warranted.

The message to 'eat salt sparingly' will not interfere with the current nutritional and legal requirements regarding iodation of table salt. A salt intake as low as 5 g per day would provide an adequate amount of iodine, provided the salt is sufficiently iodated.

Dietary factors other than sodium which have been shown to influence blood pressure include potassium, magnesium, calcium and alcohol. The 'Dietary Approaches to Stop Hypertension' (DASH) randomised controlled trial found that subjects fed a diet rich in fruit and vegetables for 8 weeks significantly reduced both systolic and diastolic blood pressure, compared with subjects on a typical American control diet. A 'combination' diet, rich in fruit, vegetables and low-fat dairy products, and with a reduced saturated and total fat intake, resulted in an even greater reduction in blood pressure. Translated into a practical diet, this information suggests a daily diet that includes large amounts of fruit and vegetables, a moderate intake of low-fat dairy products, lean meat and chicken, and a prudent alcohol intake. Salt should be used sparingly, if at all, at the table and in the preparation of meals, and the intake of processed foods high in salt should be limited. This would result in a reduction in intake from an average of around 9 g salt to about 6 g salt per day, which is the current USA recommendation. These blood pressure-related recommendations incorporate many of the various food-based dietary guidelines, emphasising that the recommendations are congruent and mutually substantive.

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Nutrition and Dietetics Unit, Department of Medicine, University of Cape Town

K E Charlton, MPhil, MSc, PG Dip Diet

Research Programme for Nutritional Intervention, Medical Research Council, Tygerberg

P L Jooste, PhD

Salt restriction as a form of treatment for hypertension was introduced at the beginning of the century when chloride could first be measured. Interestingly almost 100 years later, the merits of the salt hypothesis and the utility of its application are still being debated. The medical community is seldom as bewildered and polarised about a public health policy issue as it is regarding the role of salt in health and disease. Two opposing arguments (for¹ and against²) regarding the appropriateness of the current US dietary guideline for sodium (Na), which recommends less than 6 g sodium chloride (or < 2.4 g Na) per day, were recently published back-to-back in the *American Journal of Clinical Nutrition*.

Ecological studies have demonstrated an association between average salt consumption and blood pressure levels in populations with differing lifestyles.³ In several developing countries where the average daily salt consumption is < 3 g, blood pressure does not rise with age, and hypertension is virtually non-existent,^{4,6} whereas in populations with a typically western lifestyle, both salt intake (8 - 10 g/day) and the prevalence of hypertension are far higher.^{7,8} The INTERSALT study which included an examination of 10 074 participants from 52 centres in 32 countries, using standardised methodology, demonstrated a positive association between sodium excretion and median blood pressure when the data from all centres were included. However, when four distinctly disparate populations with very low sodium excretion values were excluded, the association no longer remained.⁹ The scientific community is generally in agreement that the INTERSALT data did not provide compelling evidence that salt intake causes hypertension.

Meta-analyses of intervention trials have demonstrated a modest reduction in blood pressure associated with sodium restriction.¹⁰⁻¹⁵ A review of 23 randomised controlled trials ($N = 1\,536$ subjects) found that a daily reduction in sodium intake of 1.7 g (i.e. 4.5 g salt) resulted in an average drop in systolic and diastolic blood pressure of 4.9 and 2.6 mmHg, respectively in hypertensive subjects, and 1.7 and 1.0 mmHg respectively, in non-hypertensives.¹³ In summary, the effects of salt restriction have been found to be as effective as the addition of a diuretic therapy (i.e. thiazide) to an ACE inhibitor in hypertensives.¹⁶ The advantage of salt restriction over diuretic therapy is that no fall in plasma potassium levels, as occurs with thiazide therapy, is seen.

DIETARY FACTORS, OTHER THAN SALT, WHICH AFFECT BLOOD PRESSURE

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The adoption of a food-based dietary guideline (FBDG) approach to nutrition education begs consideration of other foods which may contribute to blood pressure regulation. Dietary factors other than sodium which have been shown to influence blood pressure include potassium, magnesium, calcium and alcohol.¹⁷ The 'Dietary Approaches to Stop

Hypertension' (DASH) randomised controlled trial,¹⁸ conducted in a group of 459 normotensive adults (i.e. systolic BP < 160 mmHg and diastolic BP 80 - 95 mmHg) found that subjects fed a diet rich in fruit and vegetables for 8 weeks significantly reduced systolic and diastolic blood pressure by 2.8 and 1.1 mmHg more, respectively, than subjects on a typical American control diet. Subjects randomised to a 'combination' diet, rich in fruit, vegetables and low-fat dairy products, and with a reduced saturated and total fat intake (Table I) had an even greater reduction in both systolic and diastolic blood pressure, as compared with the control diet group (5.5 and 3.0 mmHg, respectively). In subjects who were hypertensive the effects were more marked; the fruit-and-vegetable-rich diet resulted in reductions of systolic and diastolic blood pressure of 3.5 and 2.1 mmHg, respectively, while the 'combination' diet resulted in corresponding reductions of 11.4 and 5.5 mmHg, respectively. It was estimated that a population-wide reduction in systolic or diastolic blood pressure of the magnitude observed with the 'combination' diet would reduce incident coronary heart disease by approximately 15% and stroke by about 27%.

The follow-up DASH II study¹⁹ has now been completed, in which the additional benefits of salt restriction over and above the merits of the DASH diet, have been demonstrated. Reducing sodium intake from the standard 3.5 g/day to either 2.4 g or 1.5 g/day in subjects on the DASH diet resulted in a minimal further drop in blood pressure. At an intake of 1.5 g sodium per day, differences between the standard diet and the DASH diet were only 2.2 mmHg. The combination of the low sodium and DASH diet lowered blood pressure by 11.5 mmHg in subjects with hypertension. It may be concluded that the greatest benefits in sodium restriction are seen in those with a poor diet (i.e. typical 'American' high-fat, low-nutrient-dense diet), particularly hypertensive subjects, and that subjects who include a large amount of fruit and vegetables, together with low-fat dairy products, may be able to tolerate higher amounts of salt. This compelling evidence further supports the shifting paradigm in provision of nutrition messages to the (often confused) public, in that a holistic approach needs to be taken, rather than the targeting of individual messages.

Epidemiological studies over the past two decades have firmly established a relationship between regular, excessive alcohol consumption and hypertension. This association has been found in both sexes of differing ethnicity, and is independent of the type of alcoholic beverage, adiposity, education, smoking, salt intake and several other factors.²⁰ It has been shown that a habitual intake of alcohol greater than 30 - 60 g per day (i.e. 3 - 5 alcoholic drinks per day) results in blood pressure elevation in both men and women.²¹ As well as its direct effect on blood pressure, alcohol can cause resistance to antihypertensive therapy²² and is an independent risk factor for stroke.²³

Table I. The DASH diet¹⁸

Food group	Daily servings	Serving sizes	Examples and notes	Significance of the Dash diet pattern
Grains and grain products	7 - 8	1 slice bread 1/2 cup (125 g) dry cereal 1/2 cup (125 g) cooked rice, pasta or cereal	Wholewheat bread, muffin, pita bread, bagel cereal, oatmeal	Major sources of energy and fibre
Vegetables	4 - 5	1 cup (250 g) raw, leafy vegetables 1/2 cup (125 g) cooked vegetables 200 ml vegetable juice	Tomatoes, potatoes, carrots, peas, squash, broccoli, turnip greens, kale, spinach, artichokes, green beans, sweet potatoes	Rich sources of potassium, magnesium and fibre
Fruits	4 - 5	1 medium fruit 1/4 cup (50 g) dried fruit 200 ml fruit juice 1/2 cup (125 g) fresh, frozen or canned fruit	Apricots, bananas, dates, oranges, orange juice, grapefruit, grapefruit juice, mangoes, melons, peaches, pineapples, prunes, raisins, strawberries, tangerines	Important sources of potassium, magnesium and fibre
Low-fat or non-fat dairy foods	2 - 3	250 ml milk 1 cup (250 ml) yogurt, 45 g cheese	Skim or low-fat (2%) milk, skim or low-fat buttermilk, non-fat or low-fat yoghurt, non-fat or low-fat cheeses	Major sources of calcium and protein
Meats, poultry and fish	≤ 2	85 g cooked meats, poultry or fish	Select only lean meats; trim away visible fats; broil, roast, or boil, instead of frying; remove skin from poultry	Rich sources of protein and magnesium
Nuts, seeds and legumes	4 - 5/wk	45 g or 1/3 cup nuts 15 g or 2 tbsp seeds 1/2 cup (125 g) cooked legumes	Almonds, mixed nuts, peanuts, walnuts, sunflower seeds, kidney beans, lentils, split peas	Rich sources of energy, magnesium, potassium, protein and fibre

The DASH eating plan shown above is based on 2 000 kcal a day (8 400 kJ/d). Depending on energy needs, the number of daily servings in a food group may vary from those listed.

The most recent US Joint National Council (JNC) VI guidelines²⁴ on lifestyle modification for the prevention and management of hypertension includes dietary changes, reduction in alcohol intake, weight loss if overweight, increased physical activity levels and smoking cessation (Table II).

Table II. Lifestyle modifications for hypertension prevention and management (JNC VI)²⁴

- Lose weight if overweight
- Limit alcohol intake to no more than 25 g ethanol (e.g. 2 cans beer, 2 glasses wine, or 2 tots spirits) per day or 12 g ethanol for women and lighter weight people
- Increase aerobic physical activity (30 - 45 min most days of the week)
- Reduce sodium intake to no more than 100 mmol/d (2.4 g sodium or 6 g sodium chloride/salt)
- Maintain adequate intake of dietary potassium (approximately 90 mmol/d)
- Maintain adequate intake of dietary calcium and magnesium for general health
- Stop smoking and reduce intake of dietary saturated fat and cholesterol for overall cardiovascular health

THE SALT SENSITIVITY PARADIGM

Blood pressure is a function of flow and resistance. The kidneys are responsible for managing the electrolyte and water content in the body, since the kidneys excrete almost all ingested electrolytes and much of the water consumed daily. Volume content is tightly controlled by the regulation of sodium (and thereby chloride) excretion. A relationship between renal salt and water excretion and blood pressure can be created for any level of blood pressure and is termed the renal pressure-natriuresis or diuresis relationship. All forms of hypertension in animal models tested to date feature a shift in the pressure-natriuresis relationship, so that a higher level of pressure is required to excrete any given amount of salt and water. The salt sensitivity of any form of hypertension is a function of the steepness of the pressure-natriuresis relationship when mapped on a graph. In normotensive individuals, the relationship between salt and water intake (and excretion) is very steep, so that little change in blood pressure occurs when salt and water intake (and excretion) are modified over a large range. Fairly flat pressure-natriuresis curves indicate salt sensitivity since blood pressure is significantly influenced by salt intake. Steep pressure-natriuresis curves indicate that blood pressure, even if elevated, is little influenced by salt.

Almost all people living in westernised societies ingest a high sodium diet; however, not all individuals respond similarly to a high salt intake. Three types of responders have been described:

Salt sensitive

Salt sensitivity can be defined as a rise in blood pressure occurring during salt administration and/or a fall in blood pressure when salt is taken away. Salt sensitivity has been shown to be reversible with weight loss — at least in young white adolescents. Definitions of salt sensitivity, in terms of absolute change in blood pressure in response to salt loading or salt depletion have been arbitrary and varied, but are generally in the region of a 3 - 5 mmHg decrease in mean arterial pressure (i.e. one-third of pulse pressure added to diastolic pressure), from baseline in response to salt depletion.

Salt resistant

Mean arterial blood pressure levels remain consistent (i.e. generally within 5 mmHg) over a wide range of salt intake.

Counter regulators

Mean arterial blood pressure levels fall during high salt intake, compared with a low salt intake. It has been suggested that this may be partially due to an overstimulation of the renin-angiotensin-aldosterone system during salt restriction.

There is no quick and easy way to predict whether an individual is salt sensitive or not. The classification has therefore remained in the research domain.

PREVALENCE OF HYPERTENSION IN SOUTH AFRICA

In South Africa, it is estimated that about 3.3 million people are hypertensive (defined as blood pressure $\geq 160/95$ mmHg and/or on antihypertensive medication).¹⁸ The first South African Demographic and Health Survey (DHS), in which blood pressure was measured in a nationally representative sample of 13 826 adults, identified the prevalence of hypertension to be 12.6% in men and 16.3% in women.¹⁹ Differences in the prevalence of hypertension between the various ethnic groups in the country are shown in Fig. 1. In contrast to studies published 10 - 20 years ago, urban/non-urban differences were negligible. Overall, only 26% of hypertensive men and 38% of hypertensive women had controlled ($\leq 160/95$ mmHg) blood pressure levels. Women fared better than men in terms of diagnosis status — 67% of all hypertensive women had previously been diagnosed, compared with 41% of hypertensive men. This finding suggests that screening for raised blood pressure, at primary level, is satisfactory, particularly for middle-aged and older women (over 60% of hypertensive women aged 45 years and older

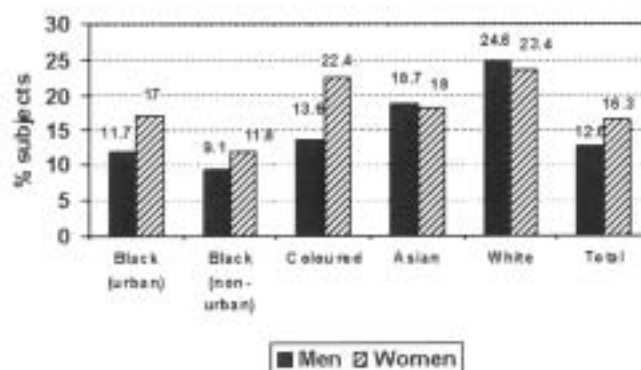


Fig. 1. Prevalence of hypertension in the South African population, according to ethnicity (N = 5 671 men; 8 155 women).¹⁹

reported being previously diagnosed). However, treatment status appears to be wholly inadequate. The high prevalence of hypertension in the country, together with the poor management of the condition, further emphasises the importance of lifestyle modification in reducing the burden of chronic diseases of lifestyle associated with raised blood pressure, namely cardiovascular disease and stroke.

High-risk groups — black South Africans, older adults and those with a family history

The salt-blood pressure hypothesis regards salt as the essential pathogenic factor. The influence of salt intake however interacts with both genetic predisposition as well as other environmental factors.²⁰ In the USA, the greater susceptibility of African-Americans than whites to hypertension and pressure-related target-organ damage has been linked to a higher prevalence of salt sensitivity (although at least 50% of white hypertensives are also salt sensitive), lower urinary potassium excretion, lower plasma renin activity, and higher circulating levels of immunoreactive parathyroid hormone and 1,25 dihydroxyvitamin D.²¹ Weinberger and colleagues²² have reported that 73% of black hypertensive patients are salt sensitive, compared with 56% of a white hypertensive group. Studies conducted in South Africa²³ have also suggested diminished activity of the sodium-potassium ATPase pump in black hypertensives. Both black South Africans and African-Americans manifest higher average blood pressure responses to calcium antagonists than to ACE inhibitors, an observation consistent with the thesis that hypertension among these groups is often salt sensitive.²⁴ More research in this area is required, particularly in light of the massive migration of black South Africans to urban areas, and the accompanying change in dietary habits, dubbed the 'nutrition transition,' which results in a higher intake of processed foods, and therefore salt.

Increasing sensitivity to salt is observed with increasing age. A randomised controlled trial in 47 people aged 60 - 78 years

who were not receiving antihypertensive medication found that a modest salt restriction from 10 g to 5 g/day resulted in a reduction of systolic and diastolic blood pressure by 7.2 and 3.2 mmHg, respectively, over a 4-week period.²⁶ More importantly, unlike studies in younger subjects, similar falls in blood pressure were seen for both normotensive and hypertensive subjects. The findings are consistent with the predictions of Law and colleagues,²⁷ who estimate that a reduction in sodium intake of 50 mmol/day (about 3 g salt) in older people would lower the population's systolic blood pressure by an average of 5 mmHg. This reduction is similar to trials of drug therapy with thiazide diuretics in this age group, in which a 36% reduction in the 5-year incidence of stroke has been estimated.²⁸ These studies provide convincing motivation for universal sodium restriction in all older people.

Children with a family history of hypertension are 30% more likely to remain in the upper quartile of systolic blood pressure than their peers. It has been postulated that a family history of hypertension is associated with salt sensitivity; however, it is unclear which genotypes, if any, may account for an increased sensitivity to salt. For the present, it is probably prudent to target individuals with a family history of hypertension to lower their salt intake as much as possible.

SALT INTAKE PATTERNS

Dietary sources of salt

Sodium chloride is approximately 40% sodium and 60% chloride. In order to calculate the salt content of food (in mg), the sodium value (in mg) should be multiplied by 2.5. In terms of quantification of salt intake, one teaspoon of salt equates to approximately 6 g sodium chloride.

The mean dietary sodium intake of American adults is 3 289 mg/day (equivalent to a salt intake of about 8 g/day),²⁹ which greatly exceeds the estimated minimum requirements of healthy non-pregnant, non-lactating adults of about 500 mg/day.³⁰ Studies of the sources of dietary sodium estimate that about three-quarters of sodium intake comes from food processing, 10 - 11% is naturally occurring (inherent) in foods, about 15% is discretionary (half of which is contributed by table salt and half by added salt in cooking) while less than 1% is provided by water.³¹ National dietary survey data from the NHANES II study³² which used a 24-hour recall method has demonstrated that the main sources of sodium in the American diet are provided by grain products, including bread, which contributes about a quarter of total intake.

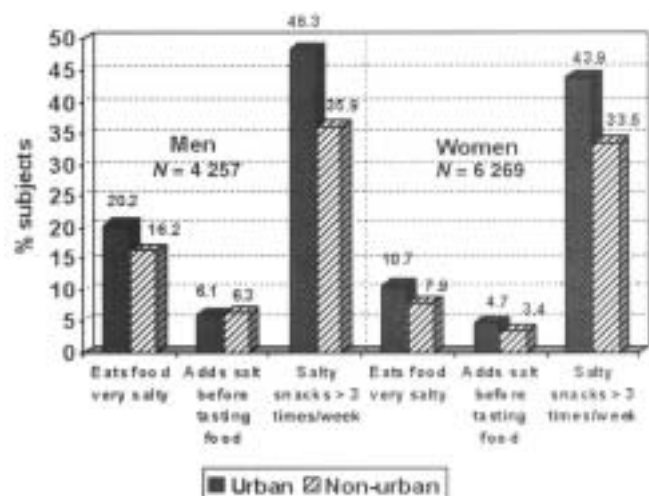
Sources of salt in the South African diet have not yet been adequately described. However, from the limited amount of information provided on some products, it is likely that grain products, particularly bread, will be a significant contributor to daily salt intake. For example, 3 - 4 slices (i.e., 150 g) of Sasko bread (figures obtained from nutritional labelling on various

Sasko products — other brands of bread are not labelled) will provide between 480 and 675 mg sodium (1.2 - 1.7 g salt), depending on the type of bread. The addition of 30 g margarine to this amount of bread will provide an extra 480 mg of sodium (1.2 g salt), which totals 2.9 g salt — almost half of the USA dietary guideline of the maximum recommended intake of 6 g salt per day!

Data from the BRISK survey³³ suggest that the average dietary intake of sodium (non-discretionary sources) in black South African subjects in peri-urban areas is highest in adolescents aged 15 - 18 years, compared with the age groups 19 - 44 and 45 - 64 years for both men (5.1; 4.0; 3.3 g/day, respectively) and women (3.3; 2.8; 2.4 g/day, respectively). However, added (discretionary) salt sources were not included in the dietary assessment method.

It is difficult to identify patterns of food intake which are associated with a high salt intake. Almost half of urban black men and women in the recent DHS³⁴ (48.3% and 43.9%, respectively) reported consuming salty snacks more than three times a week (Fig. 2).³⁵ Slightly lower prevalences were reported for non-urban black men and women (35.9% and 33.5%, respectively). Overall, a strong age trend was seen, with the 15 - 24-year age group reporting the highest consumption of salty snacks (Fig. 3). This probably relates to the higher contribution of foods eaten outside the home by adolescents and younger adults.

In the total sample, between 16% and 21% of men reported enjoying very salty food (with the exception of Asian men (6%)), compared with 8 - 17% of women (Asian women = 4%). Little differences in salt taste preferences were seen between black subjects living in urban compared with non-urban areas (Fig. 2). Practices of adding salt to food before tasting was identified in 14% of white men and women, while in the other population groups the practice was generally reported in less than 6% of subjects.



non-urban black South Africans.

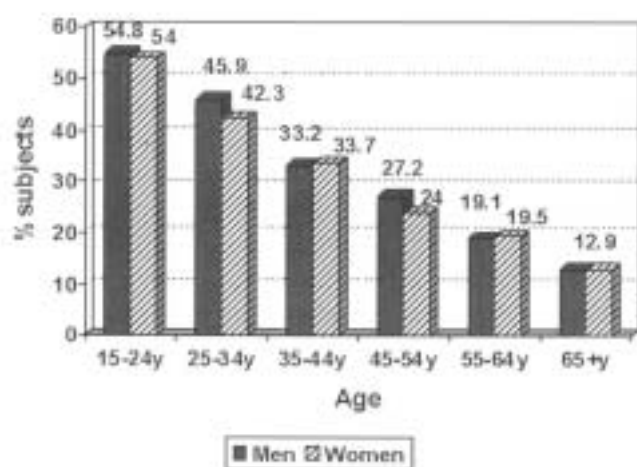


Fig. 3. Consumption of salty snacks three or more times a week by urban black South Africans, according to age group (N = 2 375 men; 3 349 women).

In-depth interviews which were held with 30 Afrikaans- and Xhosa-speaking women in the Western Cape to test the preliminary FBDGs revealed that subjects were confused about the health (negative or positive) effects of salt.¹⁶ Sixty per cent of subjects claimed that salt was 'bad for you,' while 50% thought it was 'good for you' (indicating that some subjects reported both good and bad health perceptions). The most common reason given for health benefits of salt was that it 'builds strong teeth and bones' (42%), while that given for adverse health effects was that it 'causes high blood pressure' (31%) (Fig. 4).

Difficulties in measuring salt intake

Inconsistencies between authorities in the salt-blood pressure debate may be related to the difficulties in assessing salt intake. High intra- and inter-subject variability for reporting of non-discretionary sources (i.e., salt intake which excludes table salt and salt added in cooking) has implications for the reliability of food record estimates. Indeed, it has been estimated that 81 days of dietary recording would be required to estimate an individual's intake within 10% of the observed mean.¹⁷ Seven-day recording of food intake is generally considered to be the maximum time feasible for dietary data collection. The gold standard for assessment of salt intake is considered to be the analysis of repeated 24-hour urinary sodium estimations; however, this method will not identify specific dietary sources of salt.

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Does salt appetite exist?

The question arises why humans consume sodium in quantities which far exceed physiological requirements and whether a 'salt appetite' manifests in certain individuals, as a result of either genetic programming or learned taste through exposure

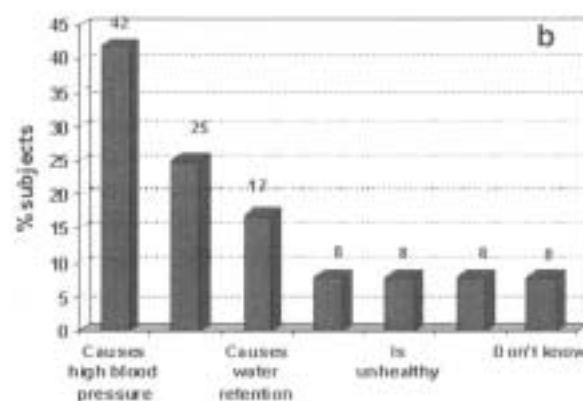
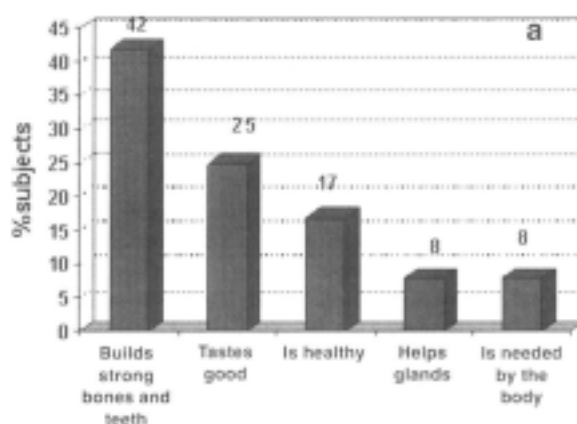


Fig. 4. Perceptions of reasons why salt is either good (a) or bad (b) for health in 30 women in the Western Cape.

to high salt intakes. As Mattes¹⁸ points out, cultural practices may contribute to salt intake patterns. A 10-fold difference in sodium intake has been reported between two Solomon Island populations which has been attributed to the one group's practice of steaming foods with fresh water whereas the other group cooked with sea water.¹⁸

The transduction of the salty taste involves passage of sodium through a specific ion channel in the apical membrane of receptor cells.¹⁹ The channel can be blocked with the drug amiloride, a potassium-sparing diuretic, and is specific; lithium, which can pass through readily is salty, whereas other cations such as potassium, which do not fit, do not taste salty. The specificity explains the difficulty in finding an acceptable salt substitute. It has been proposed that a diminished perception of the taste of salt exists in old age, which results in an increased sodium consumption.²⁰ However, Drewnowski and colleagues²¹ found no evidence for an age-associated sensory deficit in salt taste perceptions and preferences in studies of young and older subjects.

Locally, salt taste preference was tested in a sample of 22 Afrikaans-speaking women from Mitchell's Plain (mean age 43

years), drawn from a population in which hypertension has been reported to be excessively high.²⁶ Self-rated enjoyment of five differing concentrations of salt in vegetable soup was tested in random order; followed by rating of saltiness of each concentration. Ratings of the saltiness taste in the soup did not match enjoyment ratings, in which the two highest concentrations (ie. 5.06 g/l and 7.36 g/l) were rated the same, despite evidence of a drop-off of enjoyment at the highest salt concentrations (Fig. 5). The data, although limited, support the hypothesis that certain sectors of the South African population may not be able to distinguish between high salt concentrations.

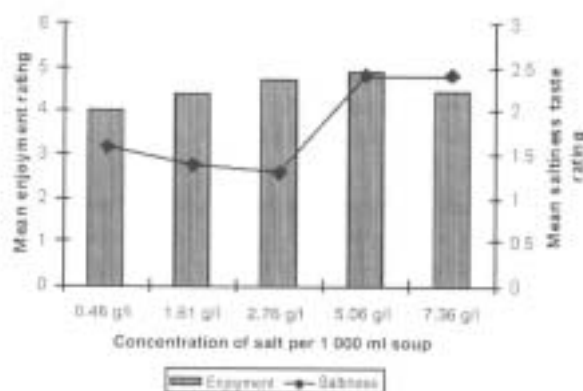


Fig. 5. Salt taste perception and enjoyment ratings of soup of various sodium concentrations in 30 women in the Western Cape.

Support for the existence of a salt appetite, defined as 'a strong motivation to seek, obtain and ingest sodium,'²⁷ that is typically manifest in cases of salt-wasting or need, originates largely from a case study in which a strong craving for salt was observed in a child with undiagnosed Addison's disease,²⁸ as well as reports of self-medication by the ingestion of liquorice, which possesses mineralocorticoid properties, in individuals with salt-wasting diseases.²⁹ Salt-craving has, however, only been described as being present in about 15% of patients with Addison's disease²⁸ and sodium depletion in humans is not accompanied by a strong and consistent craving for salt.²⁷

Food labelling — how much salt is too much?

Food labelling legislation in South Africa falls under the Foodstuffs, Cosmetics and Disinfectants Act of 1972. The food labelling regulations are currently in the process of being revised. The following categories have been proposed, with regard to health claims relating to the sodium content of foodstuffs:

- Low sodium — 120 mg per 100 g serving
- Very low sodium — 40 mg per 100 g serving
- Sodium free — 5 mg per 100 g serving.

Food manufacturers will be allowed to state the following claim on a product which complies with the above criteria: 'Diets low in sodium may reduce the risk of high blood pressure, a disease associated with many risk factors.' Generally, foods containing less than 300 mg sodium per 100 g food may be considered relatively low in sodium. This is approximately the concentration of sodium in body fluids.

Introduction of sodium on food labels will require a standardised approach by industry (e.g. whether sodium or salt (sodium chloride) content is displayed, and whether the units are given in millimoles or milligrams), and will need to be accompanied by extensive consumer training. The current South African dietary guideline has not adopted a quantitative approach with an upper recommended intake per day. This is because of a lack of information on habitual levels of dietary salt intake in various populations and also because a level of sodium restriction which is feasible to maintain long term will require the co-operation of the food industry in changing food processing techniques, rather than the targeting of individual dietary practices and food choices.

ISSUES REGARDING SALT RESTRICTION

Can excessive salt restriction have adverse health effects?

It may be argued that, providing widespread advice to the general public to reduce salt intake may be warranted if health benefits are gained by at least those individuals who are 'salt sensitive,' while at the same time those who are salt-resistant experience neither benefit nor risk. A cohort study³⁰ of 2 937 mildly and moderately hypertensive men which investigated the effects of a low salt intake on cardiovascular disease over an average of 3.8 years of follow-up, demonstrated a significant, inverse association between baseline 24-hour urinary sodium excretion (antihypertensive therapy was discontinued for 3 - 4 weeks before urine collection) and myocardial infarction, independent of several known coronary heart disease risk factors. The methodological limitations of observational studies may have contributed to the occurrence of this surprising finding.

Nevertheless, the findings of a much larger cohort³¹ study also provided some disconcerting results for the advocates of salt restriction. The first National Health and Nutrition Examination Survey (NHANES I) established baseline information during 1971 - 75 in a representative sample of 20 729 American adults aged 25 - 75 years. Half of the sample underwent medical examination and nutritional examination based on 24-hour recall. Vital status was obtained on 11 346 persons almost 20 years later and mortality was examined in gender-specific quartiles of sodium intake. In a Cox multiple regression analysis, sodium intake at baseline was significantly inversely associated with both all-cause and cardiovascular

mortality. However, when sodium intake was expressed as a function of energy intake (sodium/kcal), a direct association between sodium intake and all-cause and cardiovascular mortality was found. The authors interpreted their results cautiously and concluded that the data did not provide support regarding either an increased or decreased salt intake. The validity of a single 24-hour dietary recall method to assess habitual salt intake has been questioned.

Salt restriction: how feasible is it?

If a person is prepared to give up adding salt to food at the table, adding salt in cooking and eating processed foods which contain high amounts of salt (Table II), it is easy to reduce salt intake from the average intake of around 9 g salt (144 mmol or 3 310 mg sodium) to about 6 g salt (96 mmol or 2 200 mg sodium) per day. This is the level of sodium restriction which is usually referred to as 'no added salt' regimen (i.e. 80 - 100 mmol/day). To reduce sodium intake further requires bread and milk intake to be limited and usually results in poor compliance. Low-salt versions of bread are available in other countries, but not in South Africa at present. The trial of salt restriction in older people cited earlier in this article³⁶ made salt-free bread available to study subjects, which greatly enhanced their compliance with the level of salt restriction. As long ago as 1984, it was suggested that a relatively easy way to lower habitual sodium intakes in Australians would be to encourage the food industry to use less sodium in bread.⁶¹

It is important to inform individuals trying to lower their salt intake that their food may taste bland initially and the use of herbs and spices as alternative seasonings should be encouraged.

There is some evidence that long-term adherence to a diet low in sodium can lead to a hedonic shift whereby both normotensive⁶² and hypertensive⁶³ persons develop an increased acceptance of foods with a reduced sodium content, presumably because the salt taste receptors become more sensitive, and a lower sodium concentration provides the same salty taste as previously. However it is unclear how long such a taste adaptation would take to manifest, and whether or not the adaptation is determined by habitual salt intake.

The salt-lowering message is compatible with the national iodisation programme

Fortification of salt with iodine has been shown to be the most successful long-term public health strategy to eliminate iodine deficiency and its disastrous health consequences in more than 90 countries in the world. Iodine deficiency results in goitre, hypothyroidism and miscarriages, but its most devastating consequence is mental retardation and impaired educational attainment. While cretinism is the most extreme manifestation, of considerably greater significance are the more subtle degrees of mental impairment that lead to poor school performance,

reduced intellectual ability and impaired work capacity.

Once a deficiency of iodine has been identified in a country, iodine fortification in the form of iodated salt needs to be sustained indefinitely because of the lack of this essential micronutrient in the environment and therefore also in the food chain. In South Africa endemic goitre and iodine deficiency were observed in several areas prior to 1995.^{64,65}

To avoid the potential risk of iodine-induced hyperthyroidism associated with a rapidly increased iodine level in salt, WHO, UNICEF and ICCIDD recommend that salt should be iodated in the range of 20 - 40 ppm at the point of production.⁶⁶ When non-iodated salt is used by the food industry, the upper limit for fortification of table salt of 40 ppm is recommended, while the lower limit of 20 ppm applies when iodated salt is used in food processing. This recommendation assumes that approximately 20% of the iodine may be lost from production to the consumer and an additional 20% loss occurs during cooking.

Since 1995 salt producers have been legally obliged to fortify salt for human consumption at a concentration of between 40 and 60 parts of iodine per million parts of salt using potassium iodate. Salt packaged in quantities exceeding 20 kg per bag is exempted from this regulation. This regulation does not apply to salt used in the agricultural industry for animal nutrition and other purposes. The salt industry responded positively to the introduction of compulsory iodisation. Within 1 year, the mean iodine content of table salt in food shops increased from 14 to 33 ppm, at no extra cost to the consumer.⁶⁷ This mean value further increased to 42 ppm over the next 2 years. This level of iodisation appears appropriate in view of the use of non-iodated salt in the production of processed food, and the improved iodine status of children subsequent to the introduction of compulsory iodation.⁶⁸ Despite this progress, vulnerable groups still exposed to under- or non-iodated salt in South Africa include people living in the three northern provinces of the country, rural dwellers, people using predominantly inadequately iodated coarse salt or non-iodated agricultural salt, and low socio-economic households.⁶⁹

An iodine concentration of 40 to 60 ppm in our salt is compatible with advice to lower salt intake levels. A salt intake as low as 5 g per day would provide an adequate amount of iodine, provided that the salt is sufficiently iodated. Thus, the message to 'eat salt sparingly' will not interfere with the current nutritional and legal requirements for iodine intake in the country.

CONCLUSION

The controversy about the causal link between salt intake and hypertension, and even with cardiovascular disease, is continuing. Evidence for and against sodium restriction to control hypertension may confuse health providers and salt

consumers to the extent that opposing arguments may result in a loss of credibility in any salt-related dietary guidelines. These opposing views appear to have originated because of the difficulty of accurately measuring sodium intake in large groups of study participants, as well as the several confounders potentially affecting the salt/hypertension relationship.

Despite the controversial issues surrounding the salt-hypertension relationship, strong evidence does point to the validity of restricting salt intake to lower blood pressure. Salt-sensitive people would benefit more from salt restrictions than salt-resistant people, but the identification of these groups remains unsolved. In view of the large number of hypertensives in the population and the harmlessness of salt restrictions, it would be sensible to recommend a reduction in salt intake to the public in general and to hypertensives in particular.

Salt restriction could be achieved by reducing the amount of salt added during the cooking process and at the table. As processed foods such as bread, tinned food, cheese and snacks contain substantial amounts of salt, comprehensive labelling will allow the consumer to select low-salt products, or limit their intake of processed foods with a high-salt content. It is important to note that even a salt-restricted diet will still provide an adequate amount of iodine, provided the salt is sufficiently iodated.

Translated into a practical diet, this information suggests a daily diet that includes large amounts of fruit and vegetables, a moderate intake of low-fat dairy products, lean meat and chicken, and a prudent alcohol intake. Salt should be used sparingly, if at all, at the table and in the preparation of meals, and the intake of processed foods high in salt should be limited. These recommendations are in line with many of those of the various FBDGs, emphasising their congruent and mutually substantiative suggestions.

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WATER – THE NEGLECTED NUTRIENT

L T Bourne, J R Seager

Water is an essential nutrient and is the most pervasive compound in the human body. This paper describes typical water requirements and processes affecting homeostasis, and it explores practical issues relating to obtaining safe water.

The US National Research Council recommended water intake is 1 ml/kcal energy expenditure for adults. This equates to 2.9 l/day for men and 2.2 l/day for women under average conditions. Children require 50% more water per kcal energy expenditure. Water loss occurs via the lungs, sweat glands and kidneys. Total sweat loss is usually 500 - 700 ml/day but can reach 8 - 12 l/day.

Mean tap water intakes in Cape Town have been recorded as 2.19 l/day for whites ($N = 1\ 680$, ≥ 1 year old), 1.26 l/day for coloureds ($N = 1\ 088$, ≥ 1 year old) and 1.4 l/day for blacks ($N = 1\ 415$, ≥ 5 years old). Two litres per person per day remains a useful approximation for exposure to elements in water for local use.

The 1996 census reported that less than half the population of South Africa has an indoor water supply. In Port Elizabeth 20% of the city population was using communal water supplies (standpipes) in 1996 and 11% of these were more than 200 m from the home. Carrying and storing water impacts on both quantity and quality of water used. Such contamination contributes to the heavy burden of infectious intestinal disease (20% of deaths, in children aged 1 - 5 years). Women should be targeted in interventions since they play a critical role in water carrying, child care, and food preparation.

The guideline to 'drink lots of clean, safe water' is a unique but very important one for South Africans, living in such a hot and relatively dry climate. Water is the most pervasive compound in the human body. Most biochemical reactions occur in water, and water is an active participant in those reactions. If nothing is taken in, a person dies of thirst more quickly than of hunger.

Water is essential to life. No other substance is as widely involved in as many diverse functions of the human body as

Health and Development Research Group, Medical Research Council, Tygerberg, W Cape

L T Bourne, BSc, MSc, PhD

J R Seager, BSc Hons, PhD

water. A water deficiency manifests rapidly, and symptoms occur with as little as 1% hypohydration. In a 70-kg person, 1% hypohydration is equivalent to 700 ml of water loss or a loss of 0.7 kg of body mass due to sweating. With continued dehydration, the cardiovascular, respiratory, and thermoregulatory systems are compromised, and complete water deprivation leads to death in a matter of days. Water plays a key role in maintaining homeostasis of the internal environment for optimum function of cells.¹

This internal environment – body fluid with associated cations and anions enveloping cells – remains relatively constant despite the diversity of cells and cellular functions. The most easily appreciated roles of water in the human body are to provide a medium for transport of blood components, to dissolve and pass nutrients from blood to cells, to provide a medium for intracellular reactions to take place, and to transfer metabolic products to the blood for redistribution or elimination via the urine.¹

Water is, however, more than just a nutrient – it is a major component of the thermoregulatory system of the body. Water absorbs heat where it is generated and dissipates it over the fluid compartment of the body, minimising the risk of localised damage to enzymes or structural proteins by heat. Once the heat of chemical reactions has been transferred to body fluid, it is routed to the surface of the skin where it is dissipated by convection, radiation, conduction or evaporation.¹

REQUIREMENTS AND GUIDELINES FOR FLUID CONSUMPTION

The aim of the guideline is to provide information on hydrating the body optimally, except in the presence of abnormalities such as renal malfunction and heart failure. Dehydration of as little as 1% decrease in body weight results in impaired physiological and performance responses.^{2,4} Mild dehydration is often described as a 1 - 2% loss of body weight caused by fluid losses. It affects a wide range of cardiovascular and thermoregulatory responses.^{5,7} Dehydration in excess of 3 - 5% of body weight decreases endurance and strength^{6,8} and is the primary cause of heat exhaustion.⁹

Water is an essential nutrient because it is required in amounts that exceeds the body's ability to produce it. Even without perspiration (sensible losses) the normal daily body turnover of water is approximately 4% of total body weight in adults and the percentage is higher in children. In a 70 kg adult this is equivalent to 2 500 - 3 000 ml/day.¹⁰ Water loss from the lungs and skin (insensible losses) are responsible for half of the total turnover.¹¹ Insensible losses are sensitive to environmental conditions and can be increased at higher temperatures, high altitude and low humidity. Losses from stool and urine account for the rest of the total losses.

The human requirement for water is related to metabolism and highly variable. Insensible losses may vary widely, yet

there must be a minimal amount available to maintain a tolerable solute load by the kidneys. The US National Research Council¹¹ recommends fluid intake of 1 ml/kcal energy expenditure for adults living under average conditions of energy expenditure and environmental exposure. For average males, this is the equivalent of 2 900 ml fluid per day, and for average females 2 200 ml fluid per day. For the dependent elderly (who cannot live independently) requirements can be calculated more precisely using the following formula:

100 ml/kg for the first 10 kg body weight, and 50 ml/kg for the remaining kilograms of actual body weight. A pregnant woman requires approximately 30 ml extra fluid per day and a fully lactating woman requires 750 - 1 000 ml/day above the basic recommendation. The average recommendation for children is 1.5 ml/kcal energy expenditure per day.

The primary controller of hydration status in human beings is thirst. Unfortunately, the threshold for induction of thirst occurs when a person is already dehydrated to a level of 0.8 - 2% loss of body weight.^{12,13} This emphasises the need to hydrate the body regularly, preferably with tap water or tap water-based drinks. However, it must be borne in mind that caffeine-containing drinks such as coffee, and alcoholic drinks, have a diuretic effect. Taste influences hydration and beverage choice in adults and children.^{14,15} This highlights the need for tap water to be acceptable to consumers in terms of its potability, i.e. taste, odour and appearance.

AVENUES OF WATER GAIN AND LOSS

Water loss is influenced strongly by activity level and resultant sweat loss. The ambient environment can further influence water loss through sweat, urine and respiratory routes.

The primary source of daily water intake in humans is fluid consumption. The fluid content of food also contributes greatly to daily water balance, although this may not be universally appreciated. The combined water intake for fluids and foods consumed at meal times is the normal route for maintaining fluid balance. More than 50 years ago Rothstein *et al.*¹⁶ first pointed out the importance of eating and drinking at meal times to restore fluid balance. Although it is possible to maintain fluid balance when meals are skipped, it requires a conscious effort to drink fluids at regular intervals, since drinking invariably decreases during busy periods (when water loss is likely to be greater) and increases during periods of rest. Activity generally accentuates a gap in fluid balance, whereas leisure reduces it.¹⁶

Exercise can markedly alter not only the total fluid output, but also the relative contributions of various avenues of water output. Water is lost through the skin from both cutaneous (insensible) and sweat (sensible) losses. Insensible loss is small compared with potential sweat loss. The amount of water lost from the skin is proportional to the amount of heat generated.¹⁷

Respiratory water loss (via the lungs) is approximately equal to the amount produced by metabolism. Exercise can increase respiratory water loss to 2 - 5 ml/minute.¹⁸ Respiratory water loss also varies with climate, decreasing in hot humid weather and rising in cold climates or at high altitudes, where the cold inspired air contains little moisture and the ventilatory rate is faster.¹⁹

Although faeces contain approximately 70% water, faecal excretion in the absence of diarrhoea is relatively small because of the efficient resorption of water from the digested matter in the jejunum and colon. Diarrhoea or vomiting can increase normal daily water loss through stools from 100 ml/day to 10-50 times that amount.¹⁹

The most variable and quantitatively most important routes of water loss in humans are the sweat glands and kidneys. Sweat rates of 1 - 2 l/hour are common in athletes working at moderate to high rates of energy expenditure.^{20,21} The volume of water lost through sweat depends on several factors including work load, temperature, relative humidity, hydration status, and degree of prior heat acclimation.^{20,21} Total sweat loss is usually 500 - 700 ml/day, but can be as much as 8 - 12 l/day.²² The kidney has the ability to regulate water loss in the urine by increasing the tubular resorption of water (as in exercise or with inadequate water intake). Although water conservation by the kidney is an important homeostatic mechanism, the total quantity of water that can be conserved is relatively small compared with sweat loss during exercise.

PHYSIOLOGICAL AND PATHOLOGICAL BACKGROUND

The long-term physiological and pathological implications of less than ideal intakes of water have been thoroughly described by Kleiner²³ who pointed out that new research indicates that fluid consumption in general, and water consumption in particular, can have an effect on the risk of urinary stone disease, cancers of the breast, colon and urinary tract, child and adolescent obesity, mitral valve prolapse, salivary gland function and overall health in the elderly.

Urinary stone disease

Stone prevalence is higher in populations with low urinary volume²⁴⁻³² and increased concentrations of all stone-forming salts. Risk of stone formation increases with urine volumes of less than 1 l/day. When fluid intake is increased to allow for urinary volumes of more than 2 - 2.5 l/day, without any changes in diet or other pharmacological intervention, recurrences of all types of stones can be prevented in a large number of patients.^{24,27-29}

According to Hughes and Norman,²⁷ persons at risk for urinary stone formation should consume at least 250 ml fluid with each meal, as well as between meals, before bedtime and

when they get up at night to void. This pattern will ensure that fluid intake is spread throughout the day and that urine is not concentrated. Patients with stones should also increase their fluid intake in hotter weather and after vigorous exercise.

Cancer

Several studies have discovered a direct correlation between the quantity of fluid consumed and the incidence of certain cancers.³³⁻³⁶ In Israel, Bitterman *et al.*³³ found that patients with urinary tract cancer (bladder, prostate, kidney, testicle) consumed significantly smaller quantities of fluid compared with healthy control subjects. No association with specific beverages was found. In Hawaii, Wilkens *et al.*³⁶ showed that total fluid intake and intake of tap water in particular, had a strong inverse dose-response relationship to risk of lower urinary tract cancer (bladder, renal pelvis, ureter) among women. The association was stronger among smokers than non-smokers.

Similar findings have been made regarding colon and breast cancer. In a population-based case-control study of the association between food grouping and colon cancer in Seattle,³⁴ researchers identified a strong inverse dose-response relationship between water intake, measured as glasses of water consumed per day, and risk of colon cancer among women. Women who drank more than five glasses of water a day had a 45% decreased risk of colon cancer versus those who consumed two or fewer glasses per day (odds ratio (OR) for > 5 glasses/day v. ≤ 2 glasses/day = 0.55, 95% confidence interval (CI) = 0.31 - 0.99, *P* = 0.004). Among men there was a 32% decrease in risk with increasing water consumption (> 4 glasses/day v. ≤ 1 glass/day), although it was not statistically significant.³⁴

In a letter to the editor, Stookey and colleagues³⁵ announced the results of their hospital-based, case-control pilot study of the protective effect of drinking water on breast cancer risk. Water drinking was strongly, inversely, and significantly associated with breast cancer risk.

Obesity

People often report that drinking fluids helps them feel fuller and eat less. The LEARN programme,³⁷ a behavioural weight-control programme, suggests that participants 'drink a lot of water to take the edge off hunger'. The results of two studies may indicate that this is true in both adult and child populations.^{38,39} Levine⁴⁰ reviewed the role of liquid intake as a factor in childhood obesity and disease. She makes several important points, including the suggestion that replacing soft drinks in the diet with milk and water would help with weight control and greatly improve the overall health of the child and adult populations in the USA.

These studies therefore illustrate that insufficient water intakes can have pathological sequelae, and in some cases

additional water intake can be used in therapeutic interventions.

FLUID INTAKES OF THE SOUTH AFRICAN POPULATION

In South Africa, two studies in Cape Town¹⁰ have ascertained fluid intakes. Utilising the 24-hour recall method, mean total tap water intake for whites aged 1 year and over ($N = 1\ 680$) was 2.19 l/day, while that for coloured South Africans ($N = 1\ 088$) was 1.26 l/day.¹⁰ In a separate study, but using the same methodology, mean fluid intake for blacks ($N = 1\ 415$) aged 5 years and upwards was found to be 1.4 l/day.¹⁰ It was concluded that the 'traditional' 2 l/head/day which tends to be reported in the literature for calculation of the exposure to elements in water remains a useful approximation for local use. This 2-litre figure has been used by the World Health Organisation (WHO)¹¹ and the Environmental Protection Agency.¹²

PUBLIC HEALTH PROBLEMS RELATED TO WATER INTAKE IN SOUTH AFRICA

Considerable efforts have been made to supply South African households with water, particularly since 1994. However, according to the 1996 census¹³ there is still some way to go, with certain primarily rural provinces lagging behind in terms of providing taps inside residential dwellings. For example, in the Northern Province only 18% of households have taps inside dwellings, while in the Eastern Cape and the North West the proportion of households with indoor water is somewhat larger (25% and 31%, respectively). In contrast, however, the Western Cape (76%) and Gauteng (68%) reflect what can be attained, although in both these provinces the populations are highly urbanised. It is, however, incorrect to assume that all urban populations are adequately supplied with water. A recent study in metropolitan Port Elizabeth found that 20% of the population is reliant on communal taps and 11% of these are more than 200 m from the home.¹⁴ By population group, black South Africans have the least adequate water supplies, with only 36% of households having taps inside dwellings as opposed to 68% of coloured and 100% of white and Indian households.

Although taps inside dwellings are ideal (in terms of sanitation), this can be misleading, as access to a tap on site, or access to a public tap may go a long way towards alleviating household risk in terms of water. The national population distribution by water source is reflected in Fig. 1, which indicates that although only 45% of households have a tap inside the dwelling, as many as a further 17% have access to a tap on site, and 20% to a public tap. If one accepts that any tap-borne water is purified at some central location, at least 17.5% of households do not use centrally purified water.

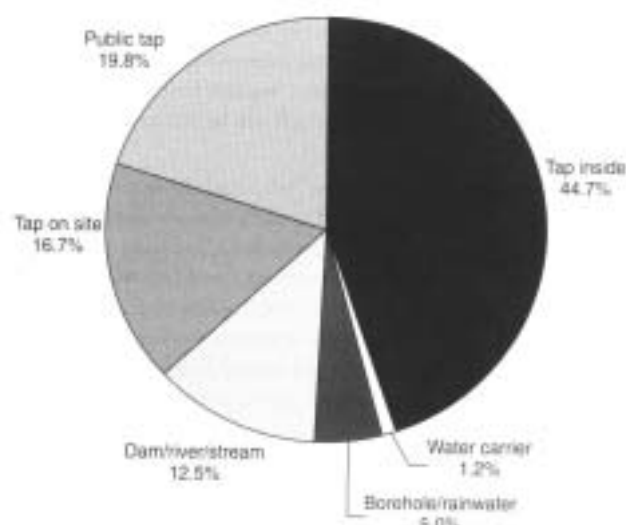


Fig. 1. National distribution of main water source (source: Statistics South Africa¹⁵).

LOCAL WATER-RELATED DISEASES

Apart from the basic metabolic demand for water as indicated above, water is a potential source or carrier of various pathogens. Potentially water-related diseases include the following: (i) water-borne diseases such as gastroenteritis, dysentery and cholera; (ii) water-washed diseases (i.e. transmission resulting from lack of adequate amounts of water or inadequate hygiene) such as shigellosis; and (iii) water-mediated diseases (i.e. water plays a role in the life cycle of the pathogen or one of its hosts) such as schistosomiasis or malaria.

According to the atlas of diarrhoeal diseases in South Africa¹⁶ ill-defined intestinal infections (diarrhoeal diseases) form the vast bulk (95.25%) of water-related disease. In South Africa 20% of deaths in the 1 - 5-year-old age range are caused by infectious intestinal diseases.¹⁶ This raises concerns regarding the handling of water by child minders. Primary prevention of diarrhoeal disease is based on interruption of the faecal-oral transmission of causative agents, and requires behavioural and environmental interventions such as sanitary waste disposal, adequate clean domestic water supplies, refuse removal and improved personal and food hygiene. Many of these objectives are outlined in the Reconstruction and Development Programme.¹⁷

Evidence from the microbiological study of water quality in households in Port Elizabeth¹⁸ suggests that faecal contamination of water occurs at various points in the chain of usage. Taps are contaminated by dirty hands, and animals when in the open air, storage containers may provide incubation sites for pathogenic organisms and drinking vessels may be washed in dirty water or contaminated during storage.

Consequently, it was concluded that mechanisms for ensuring that water supplies remain safe (up to and including the point of consumption) must go beyond mere water quality guidelines and include health and hygiene promotion, including facilitating factors, which will help consumers to obtain and use clean water.

Additional evidence from the Port Elizabeth study⁴⁹ also indicates that contamination of household water supplies is not restricted to informal housing areas, but also occurs in formal housing with supposedly adequate water and sanitation. The adverse consequences of contaminated water such as diarrhoea appear, however, to be more common in poorer communities. Mechanisms for this effect are not known but probably relate to poorer nutritional status and general environmental and domestic hygiene.

The Department of Water Affairs and Forestry White Paper on Water Supply and Sanitation⁵⁰ provides definitions applicable to the ready provision of a clean, safe water supply. Two of the key definitions are:

Quantity

Twenty-five litres per person per day is considered to be a minimum required for direct consumption, preparation of food, and personal hygiene. It is not considered to be adequate for full, healthy and productive life, which is why it is considered a minimum.⁵⁰

Quality

Once the minimum quantity of water is available, its health-related quality is as important in achieving the goal of a water supply adequate for health. The quality of water provided as a basic service should be in accordance with currently accepted standards, with regard to health-related chemical and microbial contaminants. It should also be acceptable to consumers in terms of its potability (taste, odour and appearance).⁵⁰

Two other important issues included in the White Paper⁵⁰ are distance to the supply since contamination occurs during transport and storage, and reliability of the supply. The latter is a big issue in many of the widely publicised water schemes where poor maintenance and illegal connections have resulted in very poor flow rates. The consequence is people spending long times in queues waiting and contamination of supplies because of polluted groundwater entering pipes.

WHEN IS WATER 'SAFE' FOR USE?

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To ensure that a drinking water supply is safe and does not contain any pathogenic microorganisms, it should be examined for indicators of pollution. It is impossible to test the water supply routinely for all pathogens to water-borne diseases because of the complexity of the testing process and the time and cost related to it. It is preferable to use indicator systems which are able to index the presence of pathogens and related

health risks in water. Ideally, the indicator system should fulfil a number of criteria, including the following:⁵¹ (i) it should be present when the pathogen is present and should be absent in unpolluted water; (ii) it should be present in numbers greater than the pathogen it indicates; (iii) its survival in the environment and resistance to treatment processes should be comparable to that of pathogens; (iv) it should not be harmful to human health; and (v) it should be easy to identify and isolate.

At present there is no absolute indicator which complies with all the above criteria, but the traditional indicators of drinking water quality include the coliform group (including the faecal or thermotolerant coliforms, and more specifically *Escherichia coli*) and the standard or heterotrophic plate count (HPC). As microbial drinking water quality guidelines aim at ensuring both protection of human health and the evaluation of the treatment efficacy, more than one indicator organism is often needed. Some of the indicators specifically address efficacy treatment of water with no, or very little, emphasis on human health (e.g. HPC). The coliform group of bacteria has been used much more than any other indicator group for monitoring drinking water, because it addresses both health and water treatment efficacy objectives.⁵²

An initiative has been developed as a joint venture between the South African Department of Water Affairs and Forestry and the Department of Health in the form of a tier system for evaluating water quality. The basis of this was the definition of five classes of water quality in terms of suitability of the water for drinking-water use, ranging from the ideal (Class 0) to Class 4, which is unacceptable water quality:⁵³

- Water in Class 0 ('Ideal') and Class 1 ('Good') is safe for life-time use.
- Water in Class 2 ('Marginal') may be safe for use under certain conditions but should be regarded with caution. Expert advice should be called upon to determine the real threat to sensitive users.
- Water in Class 3 ('Poor') should be considered unsafe for use and should be treated. The water may be used for short-term emergency supply but only where no alternative supplies are available.
- Water in Class 4 ('Dangerous') should be considered unsafe for use and should be treated. Water in this class is unsafe even for short-term emergency use.

People differ widely in their responses to water quality. What is safe for one person may not be safe for another. Even in the ideal class, there may be a few individuals who show some negative response. Where a few individuals may experience negative effects, these individuals have been identified as 'sensitive groups'. Sensitive groups include people who have particular medical conditions which make them more susceptible to poor water quality.⁵³

ROLE OF HYGIENE

As mentioned above, high levels of water contamination have been found in the home environment even when clean water was supplied. Improvements in water quality alone seem to have little effect on water handling practices and the subsequent contamination of stored water. Basic hygienic practices include hand washing after use of the toilet, and before and after preparing food. Contaminated water can be treated in the home by using household bleach at a concentration of 8 drops : 3.8 l water or by simply boiling it. Consequently beverages such as tea and coffee are 'safe'.

Health education involves much more than conveying simple facts or messages; it aims at getting people to think about their situation, challenge assumptions and work for change. Emphasis is placed on community participation and processes of problem solving, decision-making and empowerment. These are seen as preconditions for communities taking steps to change hygiene behaviours and improve their health.

Particularly crucial in this participation are recognition and utilisation of the key role women play as acceptors, users, managers and educators in matters of water supply and sanitation.⁵⁴⁻⁵⁶ Women influence directly the volume consumed, the quality of the water delivered to the household and the hygiene of eating utensils. In addition, it is women who form a constant link in the chain of contamination from faeces to fingers to food and who can break the chain by latrine use, hand-washing and protection of left-over food. Women therefore, can contribute to both the prevention of and recovery from diarrhoea.

ROLE OF FLUORIDE

Debates regarding the fluoridation of water in South Africa have raged for decades. Dental caries in South Africa remains a major public health problem and up to the present, general scientific consensus both locally and internationally is that benefits to dental health outweigh any potential risks. This has very recently been reviewed by Horowitz⁵⁷ from an international perspective. Current local thinking has been led by Chikte,⁵⁸ who states that 'the Department of Health together with the Department of Water Affairs and Forestry have agreed on regulations whereby provision is made to adjust the fluoride levels of the water supplies in South Africa. The regulations are in the process of legal editing and the countrywide implementation of this primary health measure now becomes imminent.'

A COMMENT ON WORLD TRENDS

During the decade 1981 - 1991 (The International Drinking Water Supply and Sanitation Decade) about 1 600 million

people were supplied with safe water. In spite of this, the WHO estimates that approximately one billion people lack safe water.⁵⁹ The major problem in the developing countries is that new sources of water that can easily be exploited are simply not available. Often additional supplies can only be obtained by diverting water from other uses, such as agriculture. Further development of new sources is technically complex and more expensive than existing projects. Inadequate pricing of water and inefficient billing further complicate the financial situation.

Diarrhoeal diseases remain the leading infectious cause of infant and child morbidity and mortality in developing countries.^{60,61} Diarrhoeal diseases have been found to account for more than one-third of paediatric deaths in most parts of the developing countries.⁶² More recently, incidence estimated using 7 350 cross-sectional surveys in 70 countries has yielded a global median incidence rate of 3.4 episodes per child per year.⁶³ This again raises questions about the actions of child minders.

CONCLUDING REMARKS

The current water supply position in South Africa is that about 12 million people out of a population of approximately 44 million do not have access to an adequate water supply. This means that a formidable task awaits the water supply industry in South Africa in the immediate future. While it is relatively easy to establish treatment plants for large water supplies, treating a large number of isolated groundwater supplies in a rural area, for example, is a major challenge. Priorities that will assist in identifying the supplies to be treated need to be established. The tier system of water quality classification in terms of suitability for drinking water use simplifies the process.

A daily intake of up to 2 l/day of 'safe, clean' water is desirable for optimal hydration, and may be taken in the form of tap water, beverages such as tea and coffee, and other tap water-based drinks. The advent of bottled 'mineral/spring' water in South Africa has made water drinking fashionable among the more affluent groups – despite the absence of safety regulations. The option of choice for the bulk of the population, however, remains the public utility.

Systems for monitoring water quality are currently biased towards measuring water quality in pipelines, which often does not correlate well with quality of water consumed. Suitable health promotion and surveillance systems need to be developed which facilitate consumption of sufficient water of good quality.

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IF YOU DRINK ALCOHOL, DRINK SENSIBLY

I V van Heerden, C D H Parry

While alcohol use has a very long history and is an ingrained part of human life, its abuse has many detrimental health, social, lifestyle and economic sequelae. Recent research has, however, identified some potentially positive health effects associated with moderate intakes of alcohol. The Food-Based Dietary Guideline (FBDG) Work Group recognised these facts and decided that it was both prudent, and necessary, to formulate a guideline on the sensible use of alcohol.

The objective of this paper is to present both the detrimental and positive aspects of alcohol intake which were considered by the FBDG Work Group in formulating the alcohol guideline.

The harmful effects of alcohol use and abuse on public health and society are divided into three categories, namely detrimental effects on adult health, teratogenic effects on the fetus and negative social and economic effects. Each category is discussed in detail and includes definitions of a standard drink for men and women, physical health hazards associated with alcohol abuse, characteristics of fetal alcohol syndrome, and social and economic consequences. South African patterns of alcohol consumption are given to highlight the need for restraint in consuming alcohol.

Findings regarding the positive effects of alcohol include the documentation of the French paradox, and the indication that moderate alcohol intake may reduce the incidence of coronary heart disease by increasing high-density lipoprotein cholesterol concentrations, and favourably modifying platelet and other clotting functions. In addition, sorghum beer, a traditional African beverage, has been found to make positive contributions to dietary intake, particularly when the beer is brewed with sorghum adjunct.

International recommendations regarding the ingestion of alcohol used in countries such as the USA and the UK, were used for purposes of comparison. The rationale on which the present alcohol guideline is based, and the reasons why the FBDG Work Group did not formulate a guideline which recommends total abstinence, are also discussed.

The final guideline proposed by the Food-Based Dietary Guidelines (FBDGs) Work Group, 'If you drink alcohol, drink sensibly', addresses the use of alcohol in South Africa.

The manufacture and consumption of alcoholic beverages has been part of mankind's evolution since the dawn of time. The ancient Greeks worshipped Bacchus, the god of wine, and viticulture and the negative consequences of excessive alcohol intake are mentioned in the first book of *The Bible*, Genesis 9: 20-27.¹

In Africa, indigenous peoples have been brewing alcoholic beverages, such as sorghum and millet beers, for centuries.² With the coming of white settlers in the 17th century, wine, barley beer and spirits were introduced to South Africa.

The use of alcohol by humans is, therefore, both a universal and a South African phenomenon, which is probably even more ingrained than most traditional eating habits. The ingestion of alcohol, particularly in excessive quantities, often has negative health and social consequences; however, recent research findings indicate that moderate intake of alcohol may benefit health in certain sectors of the population. Consequently the FBDG Work Group deemed it both necessary and prudent to include a guideline on the sensible use of alcohol.

Public health and social problems associated with ingestion of alcohol and its excessive use, include the following:

- detrimental effects on health
- teratogenic effects on the unborn
- negative social and economic effects.

The 1998 South African Demographic and Health Survey (SADHS) initiated by the Department of Health in collaboration with the Medical Research Council and Macro International, found that just under 50% of males and 17% of females 15 years and older in South Africa acknowledged consuming alcohol.³ Very high levels of 'risky drinking', particularly over weekends, were found. Groups most affected included the African, coloured, non-urban and less educated populations in South Africa. Certain population groups, such as devout Muslims, abstain from alcohol use for religious reasons.

The FBDG referring to alcohol intake recognises that many South Africans use alcohol, that this use is often excessive and leads to intoxication, that it is responsible for health and social problems, and that education and other interventions are needed to change this common practice. The FBDG on alcohol intends to make a contribution towards encouraging those members of the South African population who misuse alcohol, particularly by binge drinking, to engage in 'low-risk drinking' or 'sensible drinking'. 'Low-risk drinking' is defined as no more than four units of alcohol per day for men and no more than two units for women, with at least two alcohol-free days per week. These guidelines are based on the Australian

Private Nutrition Consultant, Menlo Park, Pretoria

Ingrid V van Heerden, DSc

Director: Alcohol and Drug Abuse Research Group, Medical Research Council, Tygerberg

Charles D H Parry, PhD

National Health and Medical Research Council's recommended daily levels of responsible alcohol intake.⁴ However, people who do not drink are not advised to start drinking in order to gain any claimed health benefit. Furthermore, it is recommended that the following groups abstain from alcohol use: children, individuals of any age who cannot restrict their drinking to moderate levels, women who are pregnant, people who are operating machinery, persons using prescription medicines, and people with a genetic tendency to alcohol dependence.

NEGATIVE ASPECTS OF ALCOHOL CONSUMPTION

The negative aspects of alcohol consumption can be divided into three categories, namely detrimental effects on health experienced by adults, teratogenic effects, and negative social and economic effects. Generally speaking, adult health sequelae and social and economic consequences tend to be linked to 'high-risk drinking', which has been defined as more than four standard drinks/day for men and more than two standard drinks/day for women (Table I).⁵ The teratogenic effects are linked to high intakes of alcohol during pregnancy.

Table I. Definition of a standard drink⁵

Drink	Average alcohol content (% volume)	One drink	Alcohol content (g)
Beer, malt	5	340 ml	12
Beer, sorghum	3	500 ml	12
Stout	6	375 ml	17
Cider	6	340 ml	16
Cooler/flavoured grape liquor	5 - 10	340 ml	8
Liqueur	30	25 ml glass	6
Sherry	17	50 ml glass	7
Brandy, whisky	43	25 ml tot	11
Gin, cane, vodka	43	25 ml tot	11
Wine	12	120 ml glass	11

Detrimental effects on adult health

The negative effects of alcohol consumption on adult health have been extensively researched and widely documented. Multiple organ system dysfunction has been directly linked to excessive alcohol intake or 'high-risk drinking' (Table II).

S72 Teratogenic effects

Ingestion of alcohol during pregnancy can have mild to severe damaging effects on the fetus. Women who drink alcohol during pregnancy are at greater risk of having a miscarriage or premature delivery. Infants born to mothers who drink alcohol during pregnancy are more likely to have a low birth weight and one or more congenital malformations. Alcohol damage to

Table II. Physical health hazards associated with alcohol abuse

Nervous system	Acute intoxication: 'hangovers' and blackouts Persistent brain damage: Wernicke's encephalopathy, Korsakoff's syndrome, cerebellar degeneration
Cerebrovascular disease	Strokes, particularly in young people Subarachnoid haemorrhage Subdural haematoma following cranial injury Withdrawal symptoms: tremor, hallucinations, fits
Liver	Nerve and muscle damage: weakness, paralysis, 'burning' sensation in extremities Fatty infiltration Alcoholic hepatitis Cirrhosis leading to liver failure Liver cancer
Gastro-intestinal system	Acid reflux Tearing/rupture of oesophagus Cancer of the oesophagus Gastritis Aggravation and impaired healing of peptic ulcers Diarrhoea and impaired absorption of food Chronic inflammation of the pancreas which may lead to diabetes and malabsorption of food
Nutrition	Malnutrition due to reduced food intake, toxic effects of alcohol on the gastrointestinal tract, impaired metabolism leading to weight loss, obesity, particularly in early stages of heavy drinking
Heart and circulation	Arrhythmias Hypertension Chronic damage to cardiac muscle leading to heart failure
Respiratory system	Pneumonia from inhalation of vomit
Endocrine system	Increased production of cortisol leading to obesity, acne, hirsutism, hypertension Condition mimicking hyperthyroidism with weight loss, anxiety, palpitations, sweating, tremor Severe hypoglycaemia resulting in coma Intense facial flushing in diabetics using chlorpropamide
Reproductive system	Men: loss of libido, impotence, testicular and penile shrinkage, reduced sperm formation leading to infertility, loss of sexual hair Women: menstrual irregularities, shrinkage of breasts and external genitalia

Adapted from James and Ralph.⁶

fetal brain cells can result in mild to severe brain damage, mental handicap or minimal brain dysfunction, e.g. dyslexia, autism, or hyperactivity.⁶

If the fetus is exposed to alcohol abuse, fetal alcohol syndrome (FAS) may occur. It is known that acetaldehyde, a metabolite of alcohol, crosses the placenta and impairs the methylation of DNA in the fetus causing characteristic effects:

- intra-uterine growth retardation resulting in low birth weight and height
- typical facial features (underdeveloped maxillary region, small fissure between the lids of the eyes)
- neurodevelopmental abnormalities, such as microcephaly
- congenital abnormalities of the joints and heart
- persistent mental retardation.⁶

The prevalence of FAS in South Africa has been shown to be much higher than in countries such as the USA. In this regard, of the one thousand children screened in their first year of school in the rural community of Wellington outside Cape Town in the late 1990s, a FAS prevalence of 40.5 - 46.4/1 000 children (age-specific rates for the entire community were 39.2 - 42.9/1 000) was reported. This prevalence is 18 - 141 times greater than prevalence estimates for the USA.⁷

The most important aspect of fetal damage caused by alcohol and FAS, is that all these negative effects can be prevented by totally abstaining from alcohol consumption during pregnancy. This injunction should be adhered to by any woman contemplating pregnancy.

Negative social effects

Heavy drinking is also associated with a wide variety of negative social and economic effects (Table III).

Cost to industry	Sickness, absence from work and lateness Reduced efficiency and decision making Higher industrial accident rate Impaired industrial relations Early retirement and premature death Higher labour turnover and cost of retraining Cost of psychiatric and medical care
Cost to health services	
Cost of social institutions	Cost of national alcohol bodies Expenditure on research and education Cost of social services
Cost of material damage	Road accidents (fatal and non-fatal, drivers and pedestrians) Abuse of family members, domestic accidents and fires
Cost of criminal activities	Policing and traffic offences Criminal offences and court cases Probation, judiciary and prison service
Undermining of society	Disintegration of family structure, abuse of family members
Dissipation of finances	Use of scarce financial resources for drinking

Adapted from James and Ralph.⁶

It is evident, therefore, that excessive or heavy alcohol intake can have far-reaching and devastating negative effects on the health, social structure and economy of a country such as South Africa. Consequently, it is therefore advisable along with other intervention strategies (e.g. increasing taxes on alcohol products) to promote public education which emphasises that persons who drink alcohol should engage in 'low-risk drinking' or 'sensible drinking', as specified in the FBDG.

THE POSITIVE ASPECTS OF ALCOHOL CONSUMPTION

While it has generally been acknowledged for centuries that the consumption of alcohol, particularly in excessive quantities, is responsible for a wide variety of society's ills, evidence of potentially positive effects are of relatively recent origin.

The so-called 'French paradox' was first reported in 1992 by Renaud and De Lorgeril.⁸ The MONICA Project, a worldwide monitoring system for cardiovascular diseases directed by the WHO, showed that the mortality from coronary heart disease (CHD) in France was similar to the incidence in Japan and China and much lower than in the USA or UK, despite the fact that the French had a saturated fat intake of 14-15% of energy and other risk factors similar to those found in western industrialised countries. This finding was dubbed the 'French paradox'. Renaud and De Lorgeril⁸ suggested that moderate alcohol intake, particularly of wine as practised in France, may protect against CHD. These authors pointed out, for instance, that when mortality from CHD in Toulouse, France was compared with that of Stanford in the USA, figures of 78 v. 182/100 000 were found, which translates into a difference of 57%. In comparison with rates for Belfast and Glasgow, CHD mortality was 78 - 79% less. Toulousians had an average alcohol consumption of 38 g/day, of which 34 g was in the form of wine. These authors suggested that wine has a greater protective effect against CHD than other alcoholic beverages. Platelet studies conducted by Renaud and De Lorgeril⁸ indicated that platelet aggregation in French subjects consuming 45 g alcohol a day was considerably lower than in Scottish subjects ingesting 20 g/day.

Initially the protective effect of alcohol against CHD was linked to the polyphenol content of wine, particularly of red wine. Polyphenols have potent anti-oxidant properties and prevent low-density lipoprotein (LDL) oxidation. However, later studies have indicated that moderate alcohol intake *per se* provides the protection against CHD.⁹ In a Chinese study of 18 244 middle-aged men (45 - 64 years), Yuan and co-workers⁹ found that subjects who consumed approximately two alcoholic drinks a day had a 19% reduction in overall mortality (relative risk 0.81; 95% confidence interval 0.70 - 0.94), after adjustment for age, level of education and cigarette smoking, compared with lifelong non-drinkers. The authors found no difference and no particular protective effects relating to the

various beverages (beer, rice wine, spirits). In relation to CHD, a 36% reduction was identified in subjects who drank moderately (defined by the study as 28 or fewer drinks per week). No protective effect was identified regarding stroke.⁹

In a review of studies investigating the positive effects of moderate alcohol intake on the incidence of CHD, published by De Groot and Zock¹⁰ in 1998, it is reported that a meta-analysis of cohort studies found that the relative risk of CHD was 0.83 for moderate drinkers (2 - 3 drinks/day), compared with abstainers. The authors suggested that alcohol *per se* may have a protective effect because it has been found to increase high-density lipoprotein (HDL) cholesterol concentrations favourably, modify platelet function and other components of clotting and fibrinolysis. They also pointed out that moderate alcohol intake decreased stress, and helped people to relax.

These findings prompted the governments of both the UK and the USA to issue recommendations advising the public to drink 'sensibly'. The UK 'sensible drinking' guidelines¹¹ state that low-risk drinking equates to drinking up to 21 units for men and up to 14 for women per week. The guidelines conclude that the causal relationship between protective effects of alcohol and CHD has been established in a 'scientifically valid' manner. They include the information that moderate intake of alcohol in 'adults who are not yet middle aged', namely men under 40 and premenopausal women, may confer protective effects against CHD in later years of life. The UK guidelines state that moderate drinking of as little as one unit a day may confer protection against risk of death from all causes. The guidelines, however, also state that by drinking nothing, individuals are not exposing themselves or society to any of the other harms associated with alcohol. The UK sensible drinking guidelines attribute the protective effect against CHD to ethanol and not to other ingredients such as polyphenols, which seems to indicate that no specific alcoholic beverage confers special protection.¹¹

The recommendations published by the government of the USA on alcohol consumption,¹² also acknowledge that a potentially beneficial relationship between moderate drinking and lowered risk of CHD exists in 'some individuals'. The USA guidelines which cover a wider field of dietary intake than the UK guidelines, counter the positive recommendation on drinking sensibly with warnings of the detrimental effects alcohol has on health. The guidelines essentially say *if you drink, do so in moderation, with food*. They do not encourage people to start drinking. Moderation is defined as no more than one drink per day for women and no more than two drinks per day for men. It must be noted that in the USA, a 'standard drink' is defined as 14 ml of absolute alcohol compared with 8 ml of absolute alcohol in the UK. The USA guidelines also stress that people with a genetic tendency to alcoholism should not drink at all.

In the African context, traditionally brewed sorghum beer

has often been equated with food because of its high nutritive content.¹³ A litre of sorghum beer brewed from sorghum malt, using unrefined sorghum as the starchy adjunct, is a relatively nutritious beverage (Table IV).¹³ This is so because the sorghum has been allowed to ferment to an endpoint which ensures lysis of the yeast cells and increases the bioavailability of B vitamins and it contains 3% alcohol or less. Table IV also compares the nutrient content per litre of sorghum beer brewed using refined maize grits or unprocessed sorghum as adjunct. The percentage contributions of nutrients by one litre of the respective beers to the South African recommended dietary allowances (RDAs),¹⁴ and the estimated safe and adequate daily dietary intake (ESADDI)¹⁵ for manganese and the estimated minimum requirement (EMR) for potassium as specified in the USA for adults,¹⁵ are also depicted.

Table IV. Comparison of the nutritive content of sorghum beer brewed with refined maize grits and unprocessed sorghum as starchy adjunct¹³

Nutrient	Maize grits adjunct		Sorghum adjunct	
	Nutritive content/ litre	%RDA/ ESADDI/ EMR	Nutritive content/ litre	%RDA/ ESADDI/ EMR
Energy (kJ)	1 475	12.3	1 695	14.1
Protein (g)	5.4	9.6	5.2	9.3
Total fat (g)	Trace	0	Trace	0
Carbohydrate (g)	41.9	-	39.9 %	-
Ethanol % (m/m)	2.31	-	3.20*	-
Thiamin (mg)	0.58	38.7	0.96*	64.0
Riboflavin (mg)	0.41	24.1	0.47	27.6
Nicotinic acid (mg)	3.03	15.9	5.58*	29.4
Calcium (mg)	53	6.6	52	6.5
Magnesium (mg)	94	23.5	178*	44.5
Phosphorus (mg)	150	18.8	305*	38.1
Iron (mg)	1.26	7.0	3.44*	19.1
Zinc (mg)	1.63	10.9	1.94*	12.9
Copper (mg)	0.17	5.7	0.27*	9.0
Manganese (mg)	0.88	25.1	1.83*	52.3 -
Sodium (mg)	21	< 1	18	< 1
Potassium (mg)	217	10.9	407*	20.4

* Significant difference between adjuncts ($P < 0.05$).
RDA = recommended dietary allowances; ¹⁴ESADDI = estimated safe & adequate daily dietary intakes; ¹⁵EMR = estimated minimum requirements.¹⁵

It is evident that sorghum beer, particularly if brewed with sorghum adjunct, can make a significant contribution to the diet with regard to the intake of energy, protein of plant origin, carbohydrate, thiamin, riboflavin, nicotinic acid, magnesium, phosphorus, iron, zinc, copper and potassium. However, it should be noted that besides industrially produced sorghum beer there are also 'home brews' and 'concoctions'. The former

are produced at home from sorghum malt/powder beer, brown bread, sugar and baker's yeast. The latter are home brews with artificially boosted alcohol content and acidity. These beers are often unhygienic and of poor quality. The alcohol content can be as high as 10%. Concoctions can also be injurious to health.

Traditionally brewed sorghum beer differs considerably from the commercially brewed product which uses refined maize as the starch source. Nowadays, the specification which restricted the ethanol content of sorghum beer to 3.0% m/m, is often exceeded. It should be noted that African populations no longer derive as much nutritional benefit from alcohol consumption, because traditional sorghum beer is increasingly being supplanted by barley beer, spirits and wine, as black South Africans become urbanised and westernised.

In view of the positive effects that moderate consumption of alcoholic beverages has on CHD and the fact that traditionally brewed sorghum beer can make a positive contribution to nutritional status, an outright ban on alcohol consumption is not warranted. That is why the South African FBDG states, 'If you drink alcohol, drink sensibly'.

PATTERNS OF ALCOHOL CONSUMPTION IN SOUTH AFRICA

The SADHS,³ which evaluated lifetime and current use of alcohol, and weekend and weekday consumption, documented that 45% of men and 17% of women, 15 years and older, acknowledge that they currently consume alcohol (Table V). The combined prevalence for alcohol consumption by men and women of 28% translates to 8.3 million South Africans who acknowledge that they currently consume alcohol. Owing to the methodology employed, this is likely to be an underestimate of the actual number of current drinkers. Various factors influence current drinking trends, namely:

- **Sex and population group.** White males (71%), white females (51%), and coloured males (45%) have the highest percentages reporting that they currently consume alcohol, whereas African females (12%) and Asian females (9%) have the lowest percentages.
- **Residence.** Drinking prevalence is higher in urban men (47%) and women (19%), than non-urban men (41%) and women (13%).
- **Province.** Drinking prevalence is highest in males living in the Free State and Gauteng (> 50%), while those living in Northern Province (28%) had the lowest prevalence. For women, those living in the Free State, Western Cape and Northern Cape reported the highest prevalence of alcohol use (23 - 25%) whereas the lowest prevalence was recorded in Northern Province (9%).
- **Age group.** The highest percentages of current drinkers for men and women were reported for the 35 - 44-year, and the 45 - 54-year age groups. The lowest levels were reported for the 15 - 24-year age group.

- **Level of education.** The highest percentages of current drinkers were found among persons with the lowest and highest levels of education (55% and 58% for men, 23% and 33% for women), whereas moderate levels of education were associated with lower percentages of current drinking (40 - 51% in men, 13 - 19% in women).

Research on 'risky drinking', defined by the SADHS as drinking 5 or more standard drinks per day for men and 3 or more standard drinks per day for women, showed that hazardous drinking is 4 - 5 times more common at weekends than during the week. Risky drinkers can be categorised from the results of this survey as follows: men aged 35 - 44, women aged 45 - 54, living in non-urban areas with a low level of education (Sub A to Standard 5), belonging to the coloured or black populations.³

There is thus no doubt that while many South Africans do not consume alcohol, almost a third of those who do, drink at risky levels over weekends. Roughly a quarter of persons aged 15 - 19 years were reported to be drinking at risky levels over weekends.³ Any educational measure which could lower the incidence of risky drinking, such as the proposed FBDG on alcohol, would therefore be considered as highly desirable.

EXAMPLES OF OTHER GUIDELINES

Many governments throughout the world have formulated guidelines concerning the use of alcohol. The UK¹¹ and USA¹² guidelines mentioned above, both inform their target audiences that moderate drinking may be beneficial to health, but that the population should drink 'sensibly'. The USA guidelines state, 'If you drink alcoholic beverages, do so in moderation, with meals, and when consumption does not put you or others at risk'. The proposed South African FBDG on alcohol is, therefore, in line with international thinking and provides balanced advice on an important facet of dietary intake. The Australian National Health and Medical Research Council indicates that 0 - 4 drinks for males and 0 - 2 drinks for females is 'responsible'.⁴

WHY NOT RECOMMEND ABSTINENCE OR A BAN ON ALCOHOL?

When faced with the overwhelming body of evidence of the harmful effects associated with excessive drinking of alcohol, it would have been understandable if the FBDG Work Group had formulated a guideline recommending total abstinence or even a government ban on the use of alcohol. Many interested parties will no doubt question why this was not done. However, recent evidence of potentially positive effects of drinking alcohol on CHD and total mortality, combined with the fact that alcohol has been used by humans since the dawn of time as a libation, a sacrament, a social lubricant and even as a food, encouraged the Work Group to try to formulate a

Table V. Percentage of males and females (≥ 15 years) reporting lifetime use of alcohol, current use of alcohol, and percentage of current drinkers engaging in risky drinking^a

Background characteristics	Total sample (5 574 males and 7 962 females)				Current drinkers (2 478 males and 1 321 females)			
	Ever drunk alcohol		Drink now (current drinking)		Risky drinking — weekdays*		Risky drinking — weekends*	
	Males	Females	Males	Females	Males	Females	Males	Females
Age								
15-24	35.5	15.9	23.5	8.5	3.1	1.2	29.3	30.1
25-34	65.7	24.5	51.8	15.6	8.4	9.1	37.2	33.4
35-44	71.8	29.4	61.1	21.0	7.5	7.4	39.0	32.4
45-54	72.8	31.6	60.1	23.5	8.1	14.0	31.7	35.3
55-64	67.2	29.8	54.2	20.4	7.6	12.5	27.2	31.8
65+	65.3	33.4	45.8	20.3	6.6	7.0	21.0	30.2
Residence								
Urban	59.9	29.2	46.7	19.2	6.4	7.1	30.0	29.5
Non-urban	55.0	20.1	41.4	13.2	8.3	12.9	38.0	39.3
Province								
Western Cape	61.4	40.1	43.6	24.2	6.1	5.4	33.4	30.2
Eastern Cape	60.2	22.3	47.5	16.2	6.5	9.8	31.4	33.6
Northern Cape	63.4	34.3	48.5	23.1	6.2	7.7	38.1	48.7
Free State	66.4	31.6	56.2	24.5	5.6	5.6	27.3	30.0
KwaZulu-Natal	54.4	17.9	39.8	11.5	8.5	14.2	31.7	37.8
North West	57.5	23.7	46.6	17.0	9.1	14.9	42.9	43.0
Gauteng	59.1	32.4	49.7	20.6	6.1	4.7	24.0	22.1
Mpumalanga	62.1	21.0	45.9	14.2	5.8	8.6	49.4	46.4
Northern	45.1	15.7	28.3	8.6	11.1	18.1	41.1	45.2
Education								
No education	70.3	33.5	54.6	22.9	6.9	14.6	36.0	38.6
Sub A - Std 3	63.2	24.2	50.7	16.3	12.1	11.3	40.3	44.6
Std 4 - Std 5	55.2	20.5	42.0	13.2	10.5	9.5	42.9	44.9
Std 6 - Std 9	51.2	20.7	39.6	12.7	4.7	7.6	30.4	32.5
Std 10	59.6	28.8	46.7	18.5	6.9	5.9	24.4	18.3
Higher	70.4	45.7	57.8	33.4	2.0	1.9	24.0	12.6
Population group								
African	53.4	18.8	41.5	12.3	7.7	13.3	35.7	42.1
African, urban	54.1	19.9	43.6	12.8	6.6	11.3	32.5	40.7
African, non-urban	52.4	17.6	38.8	11.8	9.2	15.3	40.2	43.5
Coloured	63.6	40.4	44.8	23.2	9.3	4.3	39.2	34.2
White	84.9	69.8	71.4	50.5	3.4	2.7	18.7	14.0
Asian	64.6	14.7	37.4	9.0	1.5	0.0	6.1	0.0
Total	58.1	25.7	44.7	16.9	7.0	8.8	32.8	32.4

* Defined for males as drinking ≥ 5 drinks per day, and for females as drinking ≥ 3 drinks per day.

guideline which introduces a cautionary note without being prescriptive. The sad history of Prohibition in the 1920s and 1930s in the USA should serve as a reminder that banning alcohol outright makes mankind turn to ingenious, exploitative and criminal methods of obtaining alcohol. Far better to give the public pause by pointing out that drinking alcohol can have negative consequences, but when used moderately not only contributes to enjoyment of life, but may also have health benefits to some individuals (e.g. men over 35 years and postmenopausal women).¹⁶ These benefits may occur with drinking levels as low as one drink every 2 days¹⁷ and are

replicable through other means such as stopping smoking, increasing exercise, eating a balanced, low-fat diet, and taking aspirin.¹⁸ Regularity of moderate alcohol consumption in such populations is important to maximise the health benefits of moderate drinking. Binge drinking or drinking to intoxication may well outweigh any health benefits.¹⁹

While the message about sensible 'low-risk drinking' is applicable to all South Africans who drink alcohol, the benefits are likely only to be applicable to older South Africans (men over 35 years and postmenopausal women)¹⁶ and not to the majority of South Africans who are younger. For such

populations alcohol is likely to have a net detrimental effect on mortality as a result of its role in violence and other forms of injury.²⁰ Nevertheless, it should be borne in mind that even among older South Africans risky drinking may be high, with 20 - 30% of persons aged 55 years and older in the SADHS being found to drink at risky levels (Table V).³

The FBDG 'If you drink alcohol, drink sensibly' is intended to encourage 'low-risk drinking' as part of a balanced diet, while discouraging abuse of the 'fruit of the vine', and barley, sorghum and rye distillations.

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