6 "Eat plenty of vegetables and fruit every day": a food-based dietary guideline for South Africa

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Abstract

An extensive body of research demonstrates an association between vegetable and fruit intake and reduced disease risk. Available evidence indicates that greater vegetable and fruit intake has been associated with the reduced risk of many of the nutrition-related diseases and risk factors that contribute substantially to the burden of disease in South Africa. The objective of this paper is to examine current information on vegetable and fruit intake in South Africa. Using this information and other evidence, it aimed to substantiate the need for a food-based dietary guideline (FBDG) that promotes vegetable and fruit intake, namely: "Eat plenty of vegetables and fruit every day". Furthermore, it serves to provide healthcare workers and policy-makers with background and quantitative information that is relevant the FBDG that promotes vegetable and fruit intake. Available data indicate that on national, household and individual levels in South Africa, quantities of available and consumed vegetables and fruit are much lower than the recommendations for children and adults, and the contribution of vegetables and fruit to nutrients in the diets of children is low. The evidence supports the need for a South African FBDG that promotes vegetable and fruit intake, in order to educate the public and inform policy-makers about the importance of greater vegetable and fruit intake. Practical considerations that complement this FBDG have been provided, including recommendations on variety, quantities and serving sizes across the life cycle. Recommendations for the implementation of the FBDG and overcoming barriers to eating adequate quantities of vegetables and fruit are outlined. It is recommended that evaluation and monitoring processes, at all levels of implementation of this and other FBDGs, be instituted.

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Introduction

An extensive body of research indicates that there is an association between vegetable and fruit intake and reduced disease risk. The majority of these studies have examined the risk of noncommunicable diseases (NCDs) and related risk factors. However, data exploring the link between vegetable and fruit intake and other conditions are also available, including ocular and skeletal health.

The culinary definitions of vegetables and fruit are commonly preferred, despite the fact that the botanical definitions are more accurate. Aside from these definitions, the classification of vegetables and fruit in this context should also relate to the health advantages and nutritional qualities of these foods. From a nutritional point of view, vegetables and fruit can be described as foods that are low in energy, comparatively rich in micronutrients, phytochemicals and other bioactive compounds, and good sources of dietary fibre.[1]

The nutrition-related disease risk profile in South Africa is characterised by a double burden, with both under- and overnutrition being prevalent.[2-4] The primary nutrition-related conditions and risk factors in South African children include stunting, underweight, vitamin A deficiency, the risk of inadequate micronutrient intake, overweight and obesity and the presence of early NCD risks.[2-11] In South African adults, these conditions and risk factors include cancer (lung, oesophageal and prostate in males, and cervical, breast and lung in females), diabetes, chronic respiratory diseases, overweight and obesity, cardiovascular diseases, hypertension and hypercholesterolaemia.[4,12,13] Available evidence from published systematic reviews and scientific health reports indicate that vegetable and fruit intake has been associated with a reduced risk of many of the nutrition-related diseases and risk factors that contribute substantially to the burden of disease in South Africa.[14] This evidence has been briefly summarised in Table I.

From this evidence, it is clear that interventions that aim to improve vegetable and fruit intake in the South African population have the potential to contribute to reducing the burden of nutrition-related disease, specifically by playing a role in the reduction of the risk of vitamin A deficiency in preschool children, prevalent cancers (lung and gastrointestinal), coronary heart disease, ischaemic heart disease and cerebrovascular accidents in adults.[14] However, it should be noted that most of the evidence is from observational studies, and causal mechanisms of reported associations remain to be demonstrated. Furthermore, evidence is predominantly from developed

Table I: Evidence from systematic reviews and scientific reports on the relationship between nutrition-related diseases and risks that are prevalent in South Africa, and vegetable and fruit intake[14]

Nutrition-related diseases and risks	Evidence from systematic reviews and scientific reports	Findings in brief and comments
Preschool children (< 5 years)		
Vitamin A deficiency	Systematic review of intervention studies[15]	• Increased intake of vitamin-A rich vegetables and fruit can improve biochemical vitamin A status. • Two single intervention studies in South Africa[16,17] reported that an increased intake of vitamin-A rich vegetables and fruit can improve vitamin A intake.
Adiposity	Systematic review,[18] including two longitudinal studies in preschool children[19,20]	• There is no association between vegetable and fruit intake and adiposity. • There is a positive association between vegetables and fruit and adiposity in children who are at risk of overweight and obesity. • There is limited evidence available.
School-going children and adults (> 5 years)		
Cancer	• AICR report[21] • Systematic reviews of cohort and case-control studies[22-27] • WHO Global Health Risks Report[28] • WHO Comparative Quantification of Health Risks study[29] • South African Comparative Risk Assessment[30]	• Vegetable and fruit intake is associated with a reduced risk of cancer, specifically lung and gastrointestinal cancer. • There are mostly dose-response relationships. • A proportion of cancer-related burden of disease globally and in South Africa can be attributed to a low vegetable and fruit intake.
Cardiovascular disease	• Systematic review of cohort studies[29,31-35] • WHO Global Health Risks Report[28] • WHO Comparative Quantification of Health Risks study[29] • South African Comparative Risk Assessment[30]	• Vegetable and fruit intake is inversely associated with coronary heart disease. • Vegetable and fruit intake is inversely associated with the risk of ischaemic heart disease and CVAs. • There are mostly dose-response relationships. • A proportion of the cardiovascular disease-related burden of disease globally and in South Africa is attributable to low vegetable and fruit intake, especially ischaemic heart disease and ischaemic CVAs.
Type 2 diabetes mellitus	Systematic reviews of cohort studies[36,37]	• There is no association between vegetable and fruit intake and type 2 diabetes mellitus risk. • The intake of green leafy vegetables is inversely associated with type 2 diabetes mellitus risk. • There is limited evidence available.
Obesity and adiposity	Systematic reviews of experimental and longitudinal studies[18,38]	• There are modest inverse associations between vegetable and fruit intake and adiposity, weight gain and the risk of overweight and obesity. • There is no association between vegetable and fruit intake and body weight. • The evidence is conflicting. • The clinical significance may be regarded as questionable.

AICR: American Institute for Cancer Research; CVA: cerebrovascular accidents; WHO: World Health Organisation

countries, with less data from the developing world. Consequently, risk estimates may be influenced by the varying prevalence of confounding risk factors, like smoking, obesity and infections, in developing countries such as South Africa. These findings support the need to promote optimal vegetable and fruit intake in South Africa.

Food-based dietary guidelines (FBDGs) have been promoted globally as an important part of national food and nutrition policies to educate the public and inform policy-makers about a healthy diet.[39] In line with these recommendations "Eat plenty of vegetables and fruit every day" was included in the first set of FBDGs adopted by the National Department of Health in South Africa in 2003.[40] The need to revise these FBDGs was identified by a national working group in 2011. Therefore, the objective of this paper is to examine current information on vegetable and fruit intake in South Africa. Using this information and other evidence, it aims to substantiate the need for the inclusion of this FBDG in the revised FBDGs. Furthermore, it aims to provide healthcare workers and policy-makers with background and quantitative information relevant to promoting vegetable and fruit intake.

Method

In order to examine available information on vegetable and fruit intake in South African children and adults, including changes in dietary patterns (nutrition transition), data were extracted from work in the public domain, including published research papers, scientific health reports and monographs from authoritative organisations, both globally and in South Africa, as well as from library copies of theses and dissertations.

Eligibility criteria

Human studies, published in English, that reported on the dietary intake of vegetables and/or fruit, and relevant dietary information that related to vegetables and/or fruit pertaining to South Africans of all ages, were included.

Search strategy and selection of evidence

A search was conducted in the electronic database Medline, and the African database Sabinet Online (within the "current and completed research" category of SAePublications), from January 1958 to February 2012. The search used combinations of full and truncated forms of the keywords "vegetable", "fruit", "diet", "eating", "intake", "practice" and "South Africa". Medical subject headings were used when appropriate. The websites of authoritative organisations were searched for relevant scientific reports, including the World Health Organization (WHO), Food and Agricultural Organization of the United Nations (FAO), South African Medical Research Council and Human Sciences Research Council of South Africa. Additionally, the reference lists of studies and reviews that were included were scanned to identify additional relevant studies. The titles and abstracts of publications identified by searches were screened, and pre-specified eligibility criteria applied. Potentially eligible publications were retrieved in full text for detailed evaluation and consideration for final inclusion.

Results

The search yielded a total of 510 articles. After initial screening, 39 were retrieved in full text for a more detailed evaluation, of which 13 studies met the eligibility criteria and were included. Four studies reported on vegetable and fruit intake in South African preschool children (< 5 years), and nine studies in school-going children and adults (5 years and older). Additional searches that included publications obtained from websites and reference lists were referenced accordingly.

Preschool children (< 5 years)

Secondary analysis of National Food Consumption Survey (NFCS) dietary data (quantified food frequency questionnaire) reported a mean vegetable and fruit intake of 180.2 g/day [standard deviation (SD) 135.8] in 1- to 3-year-old children, and 206.2 g (SD 181.9) in 4- to 6-year-old children.[41] Fruit excluded avocados, olives and nuts, and included juices. Vegetables excluded potatoes, sweet potatoes, mealies and sweet corn. Children from poorer households, or who were stunted or wasted, had lower intakes of vegetables and fruit compared to better nourished children or those from more affluent households. In terms of frequency of intake, vegetables and fruit were consumed 2.06 times per day (SD 1.24) by 1- to 3-year-old children and 2.16 times per day (SD 1.54) by 4- to 6-year-old children.[41] Data from smaller regional studies in South African children under five years of age also indicate poor vegetable and fruit intake. A cross-sectional survey in 4- to 24-month-old infants (n = 115) in a low socio-economic rural African community in KwaZulu-Natal reported irregular intakes of vegetables and fruit, especially those that are rich in vitamin A.[6] Only 18% of infants aged 6-12 months (n = 475) in rural KwaZulu-Natal consumed vitamin A-rich vegetables and fruit during a single 24-hour recall period.[42] According to a study in the Limpopo province, low vegetable and fruit intake was the cause of low intakes of folate, vitamin A and vitamin C in a cohort of children aged one (n = 156) and three years (n = 162).[10]

Using data from the NFCS (24-hour recall), Steyn et al reported that vitamin A-rich vegetables and fruit were eaten by only 23.8% of children, other vegetables by 30.8%, and other fruit by 22% of children. In this analysis, a dietary diversity score (DDS) was determined and validated against mean adequacy ratio (MAR) of the diet and anthropometric status. A DDS of at least 4 was demonstrated to be the lowest minimum requirement, and provided a specificity of 70% at > 50% MAR and a sensitivity of 75% at < 50% MAR of the overall diet. The diet of South African children was deemed to have a low mean DDS (3.6, SD 1.4) compared with that of other developing countries.[43] A second analysis of NFCS data (24-hour recall data) determined which foods contributed most to energy, and the macronutrient and micronutrient intakes of South African children. Overall, the contribution of vegetables and fruit to all nutrients in the diet was found to be low.[44]

School-going children and adults (> 5 years)

Analyses of the NFCS dietary data (quantified food frequency questionnaire) found that mean vegetable and fruit intake in 7- to 8.9-year-old children was 237.4 g (SD 297.7), and children in this age group consumed vegetables and fruit 2.29 times per day (SD 2.12).[41] The most recent Youth Risk Behaviour Survey, conducted in a national sample of grade 8-11 adolescents (n = 10 270, aged 11-20 years), reported that during the week preceding the survey, 58% of the sample reported consuming fresh fruit often, defined as on four or more days. Thirty-nine per cent and 50% reported that they had eaten uncooked vegetables and cooked vegetables often, respectively.[11] Data from the Transition and Health during Urbanisation of South Africans (THUSA BANA) study in the North West province reported a low intake of vegetables and fruit in a sample of 10- to 15-year-olds.[45] A recent study that assessed lunchbox behaviour in primary school learners in the Western Cape (n = 717, aged 10-

12 years) reported that only 9% of lunchboxes contained fruit.[46] Longitudinal data from the Birth to 20 study in South Africa collected at the ages of five (1995), seven (1997), nine (1999), 10 (2000) and 13 (2003) years (n = 173), showed that the number of recordings of vegetables and fruit decreased steadily in the sample from 1995 to 2003. Fruit juice showed a highly irregular pattern of recordings, with an overall increase from 1995 to 2003.[47] In peri-urban households in KwaZulu-Natal, vegetable and fruit intake was reportedly low, and average per capita intake ranged from 99 g/day for 2- to 5-year-old children (n = 73), 109 g/day for grade 6 and 7 learners (n = 399) and 124 g/day for female caregivers (n = 394).[48]

In South Africa, the prevalence of low vegetable and fruit intake (< 400 g/day) was reported to be 72.2% [95% confidence interval (CI): 69.1-75.3] in men and 66.7 (95% CI: 63-70.3) in women. This was according to data from the World Health Survey (2002-2003), which included a sample of 196 373 adults in 52 countries.[49] According to a cross-sectional survey on South Africans aged 16 years and older, representative of adults from all specified ages, provinces, geographic areas and socio-economic strata (n = 3 287), the least consumed food group was the vitamin A-rich vegetable and fruit food group, with only 17% (95% CI: 15-18) of adults having consumed an item from this group. Twenty-five per cent (95% CI: 24-27) of adults had consumed an item from the other vegetable food group and 52% (95% CI: 50-54) from the other fruit group. Variations in DDS were evident according to province area and living standards measure (LSM), but overall, most South Africans consumed a diet that was low in dietary variety (DDS 4.02, 95% CI: 3.96-4.07). The results reflected that poorer people have a diminished ability to access a large variety of food.[50]

There are no national quantitative dietary data on South African adolescents or adults. Secondary analyses have been carried out using data extrapolated from isolated surveys in adults.[51] For the South African Comparative Risk Assessment (CRA), the pooled data from these secondary analyses were re-analysed to determine the mean vegetable and fruit consumption, excluding potatoes, in g/day for adults who were older than 15 years of age.[30] The population-weighted mean per capita vegetable and fruit intake over all ages was just under three servings (235 g/day in males and 226 g/day in females). It was estimated that approximately 80% of adults 15 years and older consumed less than 400 g/day (five servings). In the CRA in 2000, low intake accounted for 3.2% of total deaths and was ranked eleventh on the list of 17 selected risk factors, accounting for 1.1% of the 16.2-million disability-adjusted life years.[30] Dietary intake data in South Africa indicate an increase in vegetable and fruit intake after urbanisation. However, consumption levels of vegetables and fruit remain below recommendations,[52,53] and are combined with dietary changes that are consistent with a population undergoing the nutrition transition, namely changes from a traditional high-carbohydrate, high-fibre, low-fat diet to one with a higher fat and sugar intake and a lower carbohydrate and fibre intake.[54]

Food balance sheets

Although they are a very crude estimate, food balance sheets provide an indication of the dietary intake of populations. The most recent national data from the FAO statistics for South Africa show that 192 g per capita per day of vegetables and fruit, excluding starchy roots, are supplied at national level (33.8 kg of fruit/capita/year or 92.6 g/person/day, and 36.1 kg of vegetables/capita/year or 98.9 g/person/day).[55]

Discussion

Vegetable and fruit intake in South Africa

Available data indicate that at national, household and individual levels in South Africa, the quantities of available and consumed vegetables and fruit are much lower than those recommended. Theoretically, vegetable and fruit intake of 192 g/day, excluding starchy roots,[55] cannot begin to meet recommendations in children or adults (Table II). Estimated intakes in all age groups[41] were well below recommendations.

To protect against certain cancers and cardiovascular disease, the WHO recommends an intake of 400 g of vegetables and fruit per day in adults, the equivalent of five servings of 80 g each.[60] This recommendation was based on a dose-response effect, which indicates an increased risk of disease at < 200 g/day, yet little benefit > 400 g/day.[61] This quantity is believed to provide sufficient micronutrients, particularly vitamin A, vitamin C, folate, vitamin E, potassium and fibre, in the diet.[62] This distributions of 480 and 600 g/day in five-to 14-year-olds and adults, respectively, were estimated for the WHO Comparative Quantification of Health Risks.[29] This is the exposure distribution that would result in the lowest population health risk, irrespective of whether or not currently attainable in practice.[59] The estimated daily intake of vegetables and fruit in South Africans aged 15 and older (235 g/day in males and 226 g/day in females)[30] were well below the 400 g/day and 600 g/day recommendations established by the WHO. The WHO estimated that increasing individual vegetable and fruit intake up to the theoretical minimum-risk distribution could reduce the global burden of disease for ischaemic heart disease 30% for men and 31% for women and for ischaemic strokes by 18% for men and 19% for women. The potential reduction in disease attributable to an increase in vegetables and fruit was 19% and 20% for cancers of the stomach and oesophagus, respectively. Attributable risk fractions were lower for lung and colorectal cancers (12% and 2%).[29]

The assumption that a standard serving of vegetables or fruit weighs approximately 80 g is widely recognised and seems appropriate. However, actual consumed servings tend to be greater than 80 g for fruit and less than 80 g for vegetables. Naturally, actual serving sizes are extensively

Table II: A comparison of estimated intakes of vegetables and fruit in South African children, and associated recommendations[41]

Estimated intakes of vegetables and fruit[41]		Recommended intake of vegetables and fruits for preschool and school-going children				
Age (in years)	g/day	Age (in years)	South African paediatric FBDGs (g/day)[56]	MyPlate (g/day)[57]	AAP (g/day)[58]	WHO theoretical minimum-risk distribution* (g/day)[29]
1-3	180	1-7	320-480			
		1			280 (1.75 cups)	
4-6	206	2-3		320 (2 cups)	320 (2 cups)	
7-9	237	4-8		400-480 (2.5-3 cups)	400-480 (2.5-3 cups)	
		0-4				330

AAP: American Academy of Pediatrics, FBDGs: food-based dietary guidelines, WHO: World Health Organization
Half a cup equivalent to 80 g
Theoretical minimum risk is the exposure distribution that would result in the lowest population health risk, irrespective of whether or not currently attainable in practice[59]

variable between individuals of the same country and across countries. When a variety of both vegetables and fruit is eaten, the average intake quantity of 80 g per serving becomes more realistic.[1]

Dietary diversity and micronutrient adequacy

Together with poor vegetable and fruit intake, the diets of many South African children and adults have a low DDS[43,50] and thus poor micronutrient adequacy, since DDS is a valid indicator of the micronutrient adequacy of the diet.[43] Dietary data in South Africa indicate that the diets of many children and adults may be low in certain essential micronutrients[3,63] and the contribution of vegetables and fruit to nutrients in the diets of children are low.[44] Dietary diversity is also deemed to be an outcome measure of food security at individual or household level.[64] In line with the predominance of low dietary variety, studies suggest that household food insecurity is widespread in South Africa, exacerbating inadequate micronutrient intakes by household members.[50,65] Low vegetable and fruit consumption has been recognised as a key contributor to micronutrient deficiencies in the developing world.[66] An increase in the diversity of food in the diet results in improved nutrient adequacy.[43] Increasing vegetable and fruit intake in the diets of South Africans across the life cycle will contribute to increased dietary diversity and improved micronutrient intakes, since vegetables and fruit are low in energy and comparatively rich in micronutrients, phytonutrients and other bioactive compounds, as well as being good sources of dietary fibre.[1] Increasing the diversity of foods provided to young children, particularly vegetables and fruit, meat, poultry, fish and eggs, is recommended in order to improve micronutrient intake.[67] Data from 11 countries on children between six and 23 months of age reported a positive association between child dietary diversity and nutritional status, independent of socio-economic factors, and reported that dietary diversity may reflect diet quality.[68]

Emphasis has been placed on the quantity of vegetables and fruit in most scientific studies that have examined vegetable and fruit intake and human health. However, research also supports an increased consumption of a variety of vegetables and fruit.[69] Globally, national guidelines, health professionals and organisations advocate the need for people to consume a variety of vegetables and fruit. This is to promote the nutritional quality of the diet. Also, by increasing variety, the likelihood for greater total intake is increased.[1,70] Recent studies suggest that variety might be an important factor in the protective effect of vegetables and fruit on human health.[71,72]

The low vegetable and fruit intake by children in the NFCS is reflected in the low frequency of the intake of vegetables and fruit (approximately twice per day).[41] It follows that encouraging frequent consumption of vegetables and fruit increases the likelihood of greater quantities of vegetable and fruit intake. Furthermore, quantitative recommendations for intake promote the daily intake of these plant foods.[57,58,60]

The promotion of vegetable and fruit intake: FBDGs

Following inclusion of the guideline "Eat plenty of vegetables and fruit every day" in the first set of FBDGs,[40] the reviewed evidence strongly supports the inclusion of this message in the 2011 revision of the FBDGs, to educate the public and inform policy-makers about the need for greater vegetable and fruit intake. This message meets recommendations that FBDGs should be short, clear and comprehensible in order to be remembered easily and to promote the implementation thereof.[73]

The FBDG in practice

Both children and adults in South Africa should aim to eat plenty of vegetables and fruit every day. The word "plenty" and the phrase "every day" require emphasis. Both promote the recommendation of high intakes of vegetables and fruit regularly. Results from the South African FBDG consumer study underlined two ways in

which the word "plenty" could be interpreted. The first was frequency, e.g. "as often as possible" and "every day", and the second was quantity, e.g. "at least two per day".[74]

Recommendations for vegetable and fruit intake for preschool children depend on age. Parents and caregivers should aim for at least 320 g of vegetables and fruit every day (four servings of 80 g) in older children in this group. The recommendation for school children and adults is at least 400 g/day of vegetables and fruit (five servings of 80 g). A guide for serving sizes is provided in Table III. These recommendations exclude white potatoes, also called Irish potatoes, as vegetables. The inclusion or exclusion of potatoes and tubers as vegetables is regarded as controversial by some. The group includes yams, sweet potatoes, cassava or manioc and taro, and the starch content of these foods varies between 12% and 50%. Several dietary guidelines place potatoes in the cereal group, while others regard potatoes as vegetables. Some dietary guidelines overtly exclude potatoes from the recommendation to increase vegetable intake.[1] According to the WHO, potatoes and starchy tubers should not be included as vegetables.[60]

A wide variety of vegetables and fruit should be consumed every day, including different coloured vegetables and fruit and various types of these plant foods. Variety can be encouraged by aiming for a daily intake of at least one serving each of cruciferous vegetables (e.g. broccoli, cauliflower, Brussels sprouts and cabbage); dark-green leafy vegetables (e.g. spinach and *imifino*, a collective term for various dark-green leaves eaten as a vegetable; the leaves either grow wild or derive from vegetables such as pumpkin, beetroot and sweet potato);[17] yellow-orange vegetables (e.g. orange-flesh sweet potato, carrots and butternut); and at least one daily serving of yellow-orange fruit types (e.g. mango and paw-paw, when in season). Some vegetables are acceptable eaten raw, while it is best to cook others to make them more digestible and palatable. Fruit should mostly be eaten fresh and raw, but can be eaten cooked or dried, preferably without added sugar. Most of the properties of the original produce are generally preserved in canned, frozen and dried vegetables and fruit.[1] Tinned and frozen vegetables and fruit, preferably without added sugar, salt or fat, can be used as nutritious alternatives to fresh vegetables and fruit. Fruit juices made from 100% pure juice provide most of the micronutrients that are present in the original fruit, but fibre is lost, and in some instances sugar is added. Many products branded as "fruit drinks" contain only small quantities of the original fruit juice.[1] Consequently, eating fruit is preferable to drinking fruit juice because of its higher fibre content, but 100% pure fruit juice is acceptable as an occasional substitute.

Table III: A guide to the serving sizes of vegetables and fruit

Vegetables or fruit	Serving size
Fresh, frozen, tinned vegetables	Half a cup (green or orange, cooked)
Leafy vegetables	One cup (raw)
Fresh fruit	One medium (whole) or two small (whole)
Fresh, frozen, tinned fruit	Half a cup (diced or cooked)
100% pure fruit or vegetable juice	125 ml (half a cup)

From six months of age, puréed and mashed vegetables and fruit are important in the diets of infants, and choices of vegetables and fruit should be varied to ensure adequate energy and nutrient intake. By 12 months of age, infants should have progressed from puréed or mashed vegetables and fruit to smaller pieces that can be eaten as "finger foods", and should consume a wide variety of vegetables and fruit, as eaten by the rest of the family. Vegetables and fruit of suitable texture should be selected and hard vegetables and fruit (e.g. raw pieces) should be avoided until the risk of choking has diminished. Different coloured, textured and tasting vegetables and fruit, both fresh and cooked, should be offered frequently to preschool children, and parents and caregivers should display model behaviour by themselves consuming a wide variety of vegetables and fruit. As with all foods, some vegetables and fruit may need to be introduced more than 10 times before being accepted by children in this age group.[75] An adequate intake of vegetables and fruit remains important throughout adulthood and into old age. Softer textured or cooked vegetables and fruit may be preferable to older people because of deteriorating dentition and taste perception. Table IV outlines practical ways to increase vegetable and fruit intake, maximising nutrients from vegetables and fruit and enabling economical vegetable and fruit purchasing.

FBDG for vegetables and fruit in other countries

The majority of other countries with FBDGs have included the promotion of vegetable and fruit intake either as a single guideline or as part of composite guideline that includes a number of food groups. The FBDGs that target vegetable and fruit intake in other developing countries mostly tend to be similar to the proposed guideline in South Africa, being only qualitative, such as the corresponding guideline in Namibia: "Eat fruit and vegetables every day". However, some developing countries have a quantitative element to the vegetable and fruit guideline, such as Chile, while certain developed countries only have a qualitative vegetable and fruit guideline, such as the UK: "Eat plenty of fruits and vegetables". The vegetable and fruit guideline in the USA is more detailed, comprehensive and quantitative: "Consume a sufficient amount of fruit and vegetables, while staying within energy needs". Two cups of fruit and two-and-a-half cups of vegetables per day are recommended for a referenced 2 000-calorie intake, with higher or lower amounts, depending on the calorie level.[77]

Barriers to eating plenty of vegetables and fruit every day

The poor vegetable and fruit intake observed among South Africans of all ages is a cause for concern. Steyn et al evaluated the dietary content of NFCS dietary data (24-hour recall) according to the FBDG in children older than seven years.[78] The guideline aimed at vegetable and fruit intake was one of those that was not being met.[44] The question that arises is: Why is vegetable and fruit intake poor, and why is there poor compliance with this FBDG?

A review of quantitative studies on the determinants of vegetable and fruit consumption in children and adolescents reported that determinants that were most consistently supported by evidence were gender, age, socio-economic position, preferences, parental intake and home availability or accessibility.[79] A study in semi-urban (n = 100) and rural (n = 100) black adults in the Northern Province reported that vegetable and fruit intake was not associated with perceived barriers to healthy eating, including preparation time and effort, dining out regularly, expense and confusing recommendations, nor perceived health benefits (i.e. the belief that the risk of developing heart disease or cancer could be reduced by increasing vegetable and fruit intake or reducing fat intake), nor knowledge of healthy eating practices. However, there was a significant correlation between good perceived eating habits and vegetable and fruit intake consumption. Rural dwellers perceived more barriers to vegetable and fruit consumption, such as expense, confusing recommendations and time and effort.[80]

Table IV: Practical approaches to increasing vegetable and fruit intake, maximising the nutrients from vegetables and fruit, and enabling economical vegetable and fruit purchasing[76]

Increasing vegetable and fruit intake
• Try a new vegetable and fruit each week. • Double the normal serving size of vegetables. • Eat raw and dried fruit and raw vegetables, and drink fruit or vegetable juices as snacks. • Eat fruit breakfast cereals and porridges that contain bananas, apples, grapes and berries. • Make a fruit salad or try baked fruit for dessert (use fruit in season). • Make fruit kebabs. • Add vegetables to sandwiches, stews, soups and curries. • Eat a vegetarian dinner at least once a week. • Enjoy a raw vegetable platter at parties. • Add vegetables to favourite pasta and rice dishes. • Use vegetables in egg dishes (e.g. onions, peppers, tomatoes and mushrooms). • Enjoy international cuisine that makes use of vegetables, such as Spanish paellas, Chinese stir-fries, Greek moussaka, French ratatouille, Mexican enchiladas and Indian curries.
Maximising nutrients from vegetables and fruits
• Shop for vegetables and fruit weekly, and consume as soon as possible. • Check the sell-by dates on packages when making a selection. • Do not leave cut vegetables and fruits to stand exposed to air or soak them in water. • Try using all parts of the plant (e.g. beetroot bulb leaves, and carrot tops). • Cook vegetables for the shortest possible time, using a minimum amount of water.
Saving money on vegetable and fruit purchases
• Buy vegetables and fruit that are in season. • Plan the weekly menu before shopping, so excess is not purchased that will spoil. • Cook and freeze excess vegetables and fruit before they spoil and use them later (e.g. in stews or desserts). • Store vegetables and fruit properly to maximise their shelf life (e.g. store bananas outside of the fridge). • When buying in bulk, first consider the storage space at home. • Pre-processed foods cost more (e.g. peeled, cut and packaged pumpkin). • Compare the cost of fresh and frozen vegetables and fruit. • Match the quality or grade of food to suit the intended purpose.

Although participants in the South African FBDG consumer study were aware of the health benefits of eating plenty of vegetables and fruit daily, they pointed out the following constraints to compliance with this guideline:[74]

- Black rural, informal urban and formal urban dwellers: Affordability (lack of household income) was regarded as the primary constraint on compliance. Cost was not mentioned as a barrier by Indian and white urban formal groups.
- All groups (black, coloured, Indian and white): Availability was strongly linked to fruit intake, and intake was highly dependent on seasonal supply fluctuations.
- All groups: Household taste preference was a barrier, with most resistance to vegetable and fruit intake from children and, in some instances, men in the households.

Similarly, in lower socio-economic groups, affordability was mentioned as a constraint to compliance with the proposed South African paediatric FBDG "Children need plenty of vegetables and fruit every day".[81] Cost was also reported to be the major barrier that prohibited daily consumption of vegetables and fruit in peri-urban households in KwaZulu-Natal, although it was less of a constraint in higher LSM groups. Frequency of usual consumption for both vegetables and fruit increased over the LSM groups.[48] Likewise, in the NFCS, greater consumption of vegetables and fruit was also demonstrated in households with a higher income.[41] Work by Drewnowski et al in the USA and France also found cost to be a major barrier to vegetable and fruit intake. A greater intake of vegetables and fruit was associated with an increase in diet costs, while energy-dense diets that were high in fat and sugar and low in vegetables and fruit were more affordable.[82,83] These findings were confirmed in a study in the Western Cape province. Healthier food choices were considerably more expensive than commonly consumed less healthy food.[84] In terms of availability, data suggest that healthier food choices, including vegetables and fruit, seem to nearly always be available in supermarkets in urban areas in South Africa. However, food costs pressure lower-income groups in these areas to select cheaper sources of energy,

such as refined cereals and foods with added sugar and fat.[84] In rural areas in the Western Cape, larger towns were typically found to have a supermarket that sold a wide selection of healthy food choices. However, in small towns, the local food stores were usually small and had a limited choice of healthy foods.[84] In summary, then, data show the affordability of vegetables and fruit to be a major barrier to adequate daily intake of these foods, especially when income levels are low, as is the case for most of the population of South Africa.[85] Availability and taste preferences have also been identified as barriers to the daily intake of plenty of vegetables and fruit in South Africa. It should also be noted that other factors within the biological environments of populations influence vegetable and fruit intake. A systematic review of psychosocial determinants of fruit and vegetable intake in adult populations reported that the most consistent variables that predicted behaviour were habits, motivation and goals, beliefs about capabilities, and knowledge and taste.[86]

Recommendations for the implementation of the FBDG and overcoming barriers thereto

Both nutrition education and communication are integral components of nutrition intervention approaches,[87] such as the FBDGs. Consequently, part of the effective implementation of the FBDG for vegetable and fruit intake includes educating the South African public about the importance and benefits of eating adequate quantities of vegetables and fruit every day. This can be achieved through effective education and communication strategies, rather than aiming to motivate and enable citizens to comply. The FAO and WHO recommend that educational materials should be developed to support the implementation of FBDGs. Material was developed by the National Department of Health following the adoption of the FBDGs in 2003.[88] It should provide additional accessible information on the practical application of increasing vegetable and fruit intake in everyday living. Suggestions of radical changes to current habits tend to be less successful than recommendations on small changes. Educational material should include visual aids that are clear and comprehensible.[73] The food guide that is currently under development by the Department of Health should be aligned with the FBDG for vegetable and fruit intake. It is recommended that stakeholders should be involved in producing educational material that promotes vegetable and fruit intake, as this enhances the quality of the material.[73]

A variety of communication strategies and media that target all age groups and levels of literacy should be used to promote vegetable and fruit consumption in South Africa. Repeated communication of the same message via different media reinforces the message and this helps to achieve a more significant impact. The content of the education, communication and intervention strategies should provide practical, affordable, accessible and culturally acceptable ways in which to improve vegetable and fruit intake, and must be tailored to suit the different population groups in South Africa. Education without practical information is less likely to be implemented by the public.[73]

Education, communication and intervention strategies should be based on practical ideas that aim to overcome the identified barriers of vegetable and fruit intake, namely taste preferences, accessibility and affordability. In this regard, the increased use of indigenous crops in the South African diet has been identified as having the potential to contribute to an increased intake of vegetables.[89] The benefits of indigenous vegetables are that they require minimum production input, are familiar, and people know how to cultivate and prepare them. Examples of indigenous vegetables include African leafy vegetables (*imifino*). In general, these vegetables grow quickly in soils of limited fertility, can be harvested within a short period of time, provide good ground cover, are relatively drought tolerant, and are often cultivated without pesticides or fertilisers.[90] Recently, the availability of, access to, and nutrition-related uses of African leafy vegetables in rural and urban households in two provinces in South Africa were determined. The authors concluded that the aforementioned factors were context specific, with differences between provinces and rural and urban areas. Consequently, findings in specific geographical areas cannot be generalised to the overall population of South Africa. In this study, amaranth was reported to have the potential to contribute significantly to the vitamin A needs of nutritionally vulnerable communities.[91] These are important considerations for education, communication and intervention strategies that aim to increase indigenous vegetable intake. The barriers of, accessibility to, and affordability of vegetables and fruit can be addressed through targeted home gardens, as recommended by Faber et al.[92]

Strategies which motivate the public to eat plenty of vegetables and fruit every day should be target all age groups, socio-economic levels and consumer domains. Identified consumer domains for vegetables and fruit in South Africa include rural smallholders (who produce vegetables and fruit for their own consumption), market-dependent consumers, mixed consumers and institutional consumers.[93] All stakeholders, particularly those at regulatory and government level, need to be involved in promoting vegetable and fruit intake, including the public sector, private sector, nongovernmental organisations, (e.g. 5-A-Day for Better Health Trust), and international stakeholders, such as the WHO. According to Dwyer, endorsement from the private sector is particularly valuable for the successful implementation of such a campagin.[94] In addition, government-related food distribution, food services and nutrition programmes should adopt and apply the guideline that promotes vegetable and fruit intake.[73] Furthermore, it is important that all messages that relate to this FBDG are consistently disseminated to all stakeholders.

The promotion of vegetables and fruit should serve as a platform for broader health strategies that form part of wider health promotion and disease prevention strategies and campaigns at population level. This has been judged to be more likely to result in behavioural change, whether targeting a specific target group or setting, or focusing on specific approaches.[95] Thomson and Ravia reiterated this in a recent systematic review in which it was stated that achieving and sustaining vegetable and fruit intake at recommended levels across the population will need stronger behavioural interventions that are strategically combined with other approaches. The latter includes efforts to use social marketing and behavioural economics to address costs, health benefits, convenience, access and availability, competitive foods and the perceived value of habitually adopting this health behaviour in an effort to decrease disease burden in the population.[96] The affordability of vegetables and fruit is a particularly important barrier in South Africa, where food insecurity affects a large percentage of the population.[50,65] The promotion of more costly foods to low-income and food-insecure households is not an effective strategy for public health.[82] It is recommended that the government and business sector implement strategies that enable poor households to comply with the FBDG "Eat plenty of vegetables and fruits every day", through adequate access to a variety of affordable vegetables and fruit.[48] This should include policies and strategies, such as the manipulation of vegetable and fruit prices through taxation and subsidies.[84] A comprehensive policy approach that takes behavioural nutrition and the economics of food choice into account is required to make healthier foods more affordable.[82]

Conclusion and recommendations

The evidence reviewed in this paper shows that vegetable and fruit intake is below recommendations in South Africans of all ages. Interventions such as the FBDG, which is aimed at improving vegetable and fruit intake, have the potential to contribute to reducing the burden of nutrition-related disease in South Africa, specifically by being a factor in the reduction of the risk of vitamin A deficiency in preschool children and of certain prevalent cancers (e.g. lung and gastrointestinal), as well as cardiovascular disease mortality, coronary heart disease, ischaemic heart disease, stroke and cardiac failure in adults. It is clear that vegetable and fruit intake needs to be promoted in South Africa. Consequently, the FBDG "Eat plenty of vegetables and fruit every day" is an essential guideline for inclusion in the revised FBDGs, in order to educate the public and inform policy makers. A number of practical considerations that complement this FBDG have been provided in this paper, including recommendations on variety, quantities and serving sizes across the life cycle. The primary barriers to vegetable and fruit intake in South Africa are affordability, availability and taste preferences. Recommendations for the implementation of the FBDG, and for overcoming barriers to eating adequate quantities of vegetables and fruit, have been outlined. The processes of evaluation and monitoring of all levels of implementation of this and other FBDGs need to be instituted, as these are invaluable in ascertaining the progress made, whether or not the target groups have been reached, and whether improvement in vegetable and fruit intake has been achieved.

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References

1. Agudo A. Measuring intake of fruit and vegetables. Kobe: Joint FAO/WHO Workshop on Fruit and Vegetables for Health; 2004 [homepage on the Internet]. Available from: http://www.who.int/dietphysicalactivity/publications/f&v_intake_measurement.pdf
2. Bosman L, Herselman MG, Kruger HS, Labadarios D. Secondary analysis of anthropometric data from a South African national food consumption survey, using different growth reference standards. Matern Child Health J. 2011;15(8):1372-1380.
3. Labadarios D, Steyn NP, Maunder E, et al. The National Food Consumption Survey (NFCS): South Africa, 1999. Public Health Nutr. 2005;8(5):533-543.
4. Norman R, Bradshaw D, Schneider M, et al. A comparative risk assessment for South Africa in 2000: towards promoting health and preventing disease. S Afr Med J. 2007;97(8 Pt 2):637-641.
5. Bourne LT, Langenhoven ML, Steyn K, et al. Nutritional status of 3-6 year-old African children in the Cape Peninsula. East Afr Med J. 1994;71(11):695-702.
6. Faber M, Benade AJ. Nutritional status and dietary practices of 4-24-month-old children from a rural South African community. Public Health Nutr. 1999;2(2):179-185.
7. Labadarios D, Middelkoop A. Children aged 6-71 months in South Africa, 1994: the anthropometric, vitamin A and iron status. Pretoria: South African Vitamin A Consultative Group; 1995.
8. Labadarios D, Steyn NP, Maunder E, et al. The National Food Consumption Survey (NFCS): children aged 1-9 years, South Africa, 1999. Pretoria: Department of Health; 2000.
9. Labadarios D, Swart R, Maunder EMW, et al. Executive summary of the National Food Consumption Survey Fortification Baseline (NFCS-FB-I) South Africa, 2005. S Afr J Clin Nutr. 2008;21(3):S247-S300.
10. Mamabolo RL, Steyn NP, Alberts M. Can the high prevalence of micronutrient deficiencies, stunting and overweight in children at ages 1 and 3 years in the Central Region of Limpopo province be explained by diet? S Afr J Clin Nutr. 2006;19(3):102-113.
11. Reddy SP, James S, Sewpaul R, et al. Umthente Uhlaba Usamila: The South African Youth Risk Behaviour Survey 2008. Cape Town: South African Medical Research Council; 2010.
12. Mayosi BM, Flisher AJ, Lalloo UG, et al. The burden of non-communicable diseases in South Africa. Lancet. 2009;374(9693):934-947.
13. Norman R, Bradshaw D, Groenewald P, et al. Revised burden of disease estimates for the Comparative Risk Factor Assessment, South Africa 2000. Cape Town: South African Medical Research Council; 2006.
14. Naude CE. Would an increase in vegetable and fruit intake help reduce the burden of nutrition-related disease in South Africa? An umbrella review of the evidence. S Afr J Clin Nutr. 2013;26(3):104-114.
15. Masset E, Haddad L, Cornelius A, Isaza-Castro J. A systematic review of agricultural interventions that aim to improve nutritional status of children [homepage on the Internet]. 2011: Available from: http://www.dfid.gov.uk/R4D/PDF/Outputs/SystematicReviews/Masset_etal_agriculture_and_nutrition.pdf
16. Faber M, Laubscher R. Seasonal availability and dietary intake of beta-carotene-rich vegetables and fruit of 2-year-old to 5-year-old children in a rural South African setting growing these crops at household level. Int J Food Sci Nutr. 2008;59(1):46-60.

17. Faber M, van Jaarsveld PJ, Laubscher R. The contribution of dark-green leafy vegetables to total micronutrient intake of two- to five-year-old children in a rural setting. Water SA. 2007;33(3):407-412.
18. Ledoux TA, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adiposity: a systematic review. Obes Rev. 2011;12(5):e143-e150.
19. Faith MS, Dennison BA, Edmunds LS, Stratton HH. Fruit juice intake predicts increased adiposity gain in children from low-income families: weight status-by-environment interaction. Pediatrics. 2006;118(5):2066-2075.
20. Newby PK, Peterson KE, Berkey CS, et al. Dietary composition and weight change among low-income preschool children. Arch Pediatr Adolesc Med. 2003;157(8):759-764.
21. American Institute for Cancer Research, World Cancer Research Fund. Food, Nutrition, Physical Activity, and the Prevention of Cancer. A global perspective. Washington DC: AICR; 2007.
22. Aune D, Lau R, Chan DS, et al. Nonlinear reduction in risk for colorectal cancer by fruit and vegetable intake based on meta-analysis of prospective studies. Gastroenterology. 2011;141(1):106-118.
23. Kim HJ, Lim SY, Lee JS, et al. Fresh and pickled vegetable consumption and gastric cancer in Japanese and Korean populations: a meta-analysis of observational studies. Cancer Sci. 2010;101(2):508-516.
24. Lam TK, Gallicchio L, Lindsley K, et al. Cruciferous vegetable consumption and lung cancer risk: a systematic review. Cancer Epidemiol Biomarkers Prev. 2009;18(1):184-195.
25. Soerjomataram I, Oomen D, Lemmens V, et al. Increased consumption of fruit and vegetables and future cancer incidence in selected European countries. Eur J Cancer. 2010 Sep;46(14):2563-2580.
26. Wakai K, Matsuo K, Nagata C, et al. Lung cancer risk and consumption of vegetables and fruit: an evaluation based on a systematic review of epidemiological evidence from Japan. Jpn J Clin Oncol. 2011;41(5):693-708.
27. Zhou Y, Zhuang W, Hu W, et al. Consumption of large amounts of Allium vegetables reduces risk for gastric cancer in a meta-analysis. Gastroenterology. 2011;141(1):80-89.
28. World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva: World Health Organization; 2009.
29. Lock K, Pomerleau J, Causer L, McKee M. Global burden of disease due to low fruit and vegetable consumption. In: Ezzati M, Lopez AD, Rodgers A, Murray CJL, editors. Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors. Geneva: World Health Organisation, 2004; p. 597-728.
30. Schneider M, Norman R, Steyn NP, Bradshaw D. Estimating the burden of disease attributable to low fruit and vegetable intake in South Africa in 2000. S Afr Med J. 2007;97(8):717-723.
31. Dauchet L, Amouyel P, Hercberg S, Dallongeville J. Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies. J Nutr. 2006;136(10):2588-2593.
32. He FJ, Nowson CA, Lucas M, MacGregor GA. Increased consumption of fruit and vegetables is related to a reduced risk of coronary heart disease: meta-analysis of cohort studies. J Hum Hypertens. 2007;21(9):717-728.
33. Dauchet L, Amouyel P, Dallongeville J. Fruit and vegetable consumption and risk of stroke: a meta-analysis of cohort studies. Neurology. 2005;65(8):1193-1197.
34. He FJ, Nowson CA, MacGregor GA. Fruit and vegetable consumption and stroke: meta-analysis of cohort studies. Lancet. 2006;367(9507):320-326.
35. Law MR, Morris JK. By how much does fruit and vegetable consumption reduce the risk of ischaemic heart disease? Eur J Clin Nutr. 1998;52(8):549-556.
36. Carter P, Gray LJ, Troughton J, et al. Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis. BMJ. 2010;341:c4229.
37. Hamer M, Chida Y. Intake of fruit, vegetables, and antioxidants and risk of type 2 diabetes: systematic review and meta-analysis. J Hypertens. 2007;25(12):2361-2369.
38. Alinia S, Hels O, Tetens I. The potential association between fruit intake and body weight: a review. Obes Rev. 2009;10(6):639-647.
39. World Health Organization. Global strategy on diet, physical activity and health. Geneva: World Health Organization; 2004.
40. Love P, Sayed N. Eat plenty of vegetables and fruit every day. S Afr J Clin Nutr. 2001;14(3):S24-S32.
41. Naude CE. Fruit and vegetable consumption by South African children, aged 12 to 108 months: a secondary analysis of the National Food Consumption Survey data. Stellenbosch: Stellenbosch University; 2007.
42. Faber M. Complementary foods consumed by 6-12-month-old rural infants in South Africa are inadequate in micronutrients. Public Health Nutr. 2005;8(4):373-381.
43. Steyn NP, Nel JH, Nantel G, et al. Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? Public Health Nutr. 2006;9(5):644-650.
44. Steyn NP, Maunder EMW, Labadarios D, Nel JH. Foods and beverages that make significant contributions to macro- and micronutrient intakes of children in South Africa: do they meet the food-based dietary guidelines? S Afr J Clin Nutr. 2006;19(2):66-76.
45. Rossouw CR. Eating habits and nutrient intakes of 10-15 year old children in the North West Province Potchefstroom: North West University; 2005.
46. Abrahams Z, de Villiers A, Steyn NP, et al. What's in the lunchbox? Dietary behaviour of learners from disadvantaged schools in the Western Cape, South Africa. Public Health Nutr. 2011;14(10):1752-1758.
47. Pedro TM, MacKeown JM, Norris SA. Variety and total number of food items recorded by a true longitudinal group of urban black South African children at five interceptions between 1995 and 2003: the Birth-to-Twenty (Bt20) Study. Public Health Nutr. 2008;11(6):616-623.
48. Faber M, Laubscher R, Laurie S. Availability of, access to and consumption of fruits and vegetables in a peri-urban area in KwaZulu-Natal, South Africa. Matern Child Nutr. 2013;9(3):409-424.
49. Hall JN, Moore S, Harper SB, Lynch JW. Global variability in fruit and vegetable consumption. Am J Prev Med. 2009;36(5):402-409. e5.
50. Labadarios D, Steyn NP, Nel J. How diverse is the diet of adult South Africans? Nutr J. 2011;10:33.
51. Steyn NP, Nel JH, Casey A. Secondary data analyses of dietary surveys undertaken in South Africa to determine usual food consumption of the population. Public Health Nutr. 2003;6(7):631-644.
52. Steyn K, Fourie J, Temple Ne. Chronic diseases of lifestyle in South Africa: 1995-2005. Cape Town: South African Medical Research Council; 2006.
53. Vorster HH, Venter CS, Wissing MP, Margetts BM. The nutrition and health transition in the North West Province of South Africa: a review of the THUSA (Transition and Health during Urbanisation of South Africans) study. Public Health Nutr. 2005;8(5):480-490.
54. Steyn NP, Bradshaw D, Norman R, et al. Dietary changes and the health transition in South Africa: implications for health policy. Cape Town: South African Medical Research Council; 2006.
55. Food and Agriculture Organization statistics: food balance sheets [homepage on the Interent]. 2007. c2012. Available from: http://faostat.fao.org/site/368/default.aspx#ancor
56. Bowley NA, Pentz-Kluyts MA, Bourne LT, Marino LV. Feeding the 1 to 7-year-old child. A support paper for the South African paediatric food-based dietary guidelines. Matern Child Nutr. 2007;3(4):281-291.
57. US Department of Agriculture. MyPlate [homepage on the Internet]. 2011. c2012. Available from: http://www.choosemyplate.gov/food-groups
58. Gidding SS, Dennison BA, Birch LL, et al. Dietary recommendations for children and adolescents. Circulation. 2005;112(13):2061-2075.
59. Murray CJ, Ezzati M, Lopez AD, et al. Comparative quantification of health risks conceptual framework and methodological issues. Popul Health Metr. 2003;1(1):1.
60. World Health Organization/Food and Agricultural Organization. Diet, nutrition and the prevention of chronic disease. Report of a joint WHO/FAO expert consultation. Geneva: World Health Organization; 2003.
61. Smith-Warner SA, Spiegelman D, Yaun SS, et al. Intake of fruits and vegetables and risk of breast cancer: a pooled analysis of cohort studies. JAMA. 2001;285(6):769-776.

62. World Health Organization. WHO fruit and vegetable promotion initiative: report of the meeting, Geneva, 25-27 August 2003. Geneva: World Health Organization; 2003.
63. Steyn NP, Nel J. Dietary intake of adult women in South Africa and Nigeria with a focus on the use of spreads. Cape Town: South African Medical Research Council and Stellenbosch University; 2006.
64. Hoddinott J. Choosing outcome indicators of household food security. Washington DC: International Food Policy Research Institute;1999.
65. Charlton KE, Rose D. Prevalence of household food poverty in South Africa: results from a large, nationally representative survey. Public Health Nutr. 2002;5(3):383-389.
66. Ruel MT, Minot N, Smith L. Patterns and determinants of fruit and vegetable consumption in sub-Saharan Africa: a multicountry comparison. Kobe: Joint FAO/WHO; 2004 [homepage on the Internet]. Available from: http://www.who.int/dietphysicalactivity/publications/f&v_africa_economics.pdf
67. Pan American Health Organization /World Health Organization. Guiding principles for complementary feeding of the breastfed child. Washington DC: PAHO/WHO; 2003.
68. Arimond M, Ruel MT. Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. J Nutr. 2004;134(10):2579-2585.
69. Van Duyn MA, Pivonka E. Overview of the health benefits of fruit and vegetable consumption for the dietetics professional: selected literature. J Am Diet Assoc. 2000;100(12):1511-1521.
70. Hyson DA. Fruits, vegetables and health: a scientific overview, 2011. Hockessin: Produce for Better Health Foundation; 2011.
71. Bhupathiraju SN, Tucker KL. Greater variety in fruit and vegetable intake is associated with lower inflammation in Puerto Rican adults. Am J Clin Nutr. 2011;93(1):37-46.
72. Buchner FL, Bueno-de-Mesquita HB, Ros MM, et al. Variety in fruit and vegetable consumption and the risk of lung cancer in the European prospective investigation into cancer and nutrition. Cancer Epidemiol Biomarkers Prev. 2010;19(9):2278-2286.
73. Food and Agricultural Organization/World Heath Organization. Preparation and use of food-based dietary guidelines. Geneva: World Health Organization; 1998.
74. Love P, Maunder E, Green M, et al. South African Food-Based Dietary Guidelines: testing of the preliminary guidelines among women in KwaZulu-Natal and the Western Cape. S Afr J Clin Nutr. 2001;14(1):9-19.
75. Birch LL. Development of food preferences. Annu Rev Nutr. 1999;19:41-62.
76. Steinmetz KA, Potter JD. Vegetables, fruit, and cancer prevention: a review. J Am Diet Assoc. 1996;96(10):1027-1039.
77. Food and Agricultural Organization. Food-based dietary guidelines by country [homepage on the Internet]. 2012. Available from: http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/en/
78. Vorster HH, Love P, Browne C. Development of food-based dietary guidelines for South Africa: the process. S Afr J Clin Nutr. 2001;14(3):S3-S6.
79. Rasmussen M, Krolner R, Klepp KI, et al. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. Int J Behav Nutr Phys Act. 2006;3:22.
80. Peltzer K, Promtussananon S. Knowledge, barriers, and benefits of fruit and vegetable consumption and lay conceptions of nutrition among rural and semi-urban black South Africans. Psychol Rep. 2004;94(3):976-982.
81. Bourne LT, Marais D, Love P. The process followed in the development of the paediatric food-based dietary guidelines for South Africa. Matern Child Nutr. 2007;3(4):239-250.
82. Drewnowski A, Darmon N. Food choices and diet costs: an economic analysis. J Nutr. 2005;135(4):900-904.
83. Drewnowski A, Darmon N, Briend A. Replacing fats and sweets with vegetables and fruits: a question of cost. Am J Public Health. 2004;94(9):1555-1559.
84. Temple NJ, Steyn NP, Fourie J, De Villiers A. Price and availability of healthy food: a study in rural South Africa. Nutrition. 2011;27(1):55-58.
85. Leatt A. Income poverty in South Africa, South African child gauge 2006. Childrens Institute [homepage on the Internet]. c2012. Available from: http://ci.org.za/depts/ci/pubs/pdf/general/gauge2006/gauge2006_incomepoverty.pdf
86. Guillaumie L, Godin G, Vezina-Im LA. Psychosocial determinants of fruit and vegetable intake in adult population: a systematic review. Int J Behav Nutr Phys Act. 2010;7:12.
87. Stuart TH, Achterberg C. Education and communication strategies for different groups and settings. Rome: Food and Agricultural Organization; 1997 [homepage on the Internet]. Available from: http://www.fao.org/docrep/W3733E/W3733E00.htm
88. Keller I, Lang T. Food-based dietary guidelines and implementation: lessons from four countries: Chile, Germany, New Zealand and South Africa. Public Health Nutr. 2008;11(8):867-874.
89. Maunder E, Meakers JL. The current and potential contribution of home-grown vegetables to diets in South Africa. Water SA. 2007;33(3):401-406.
90. Shiundu KM. Role of African leafy vegetables in alleviating food and nutrition insecurity in Africa. African Journal of Food and Nutrition Sciences. 2002;2(2):96-97.
91. Faber M, Oelofse A, Van Jaarsveld PJ, et al. African leafy vegetables consumed by households in the Limpopo and KwaZulu-Natal provinces in South Africa. S Afr J Clin Nutr. 2010;23(1):30-38.
92. Faber M, Venter SL, Benade AJ. Increased vitamin A intake in children aged 2-5 years through targeted home-gardens in a rural South African community. Public Health Nutr. 2002 ;5(1):11-16.
93. De Witt C. The development of a strategy to promote fruit and vegetable consumption in South Africa Potchefstroom: North-West University; 2005.
94. Dwyer JT. Nutrition guidelines and education of the public. J Nutr. 2001;131(11 Suppl):3074S-3077S.
95. Stockley L. Toward public health nutrition strategies in the European Union to implement food based dietary guidelines and to enhance healthier lifestyles. Public Health Nutr. 2001;4(2A):307-324.
96. Thomson CA, Ravia J. A systematic review of behavioral interventions to promote intake of fruit and vegetables. J Am Diet Assoc. 2011;111(10):1523-1535.