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

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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.

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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. Underwood[1] 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. Underwood[1] also

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 literature[2] 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 Africans[4] shows that intakes of several micronutrients, notably calcium, iron, magnesium, zinc, riboflavin, vitamins A, B_6, C and folate are low. The new perception[1] 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 countries[6-10]

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
USAguidelines	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
Trans 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 caroteinoids (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.[16]

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 B_{12}. Breast-fed infants from these mothers can often develop a fatal disorder characterised by body tremors, facial twitches, psycomotor retardation and shrinkage of the brain, caused by a vitamin B_{12} 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 B_{12}, 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 B_{12}, 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 B_{12} needs. Vegans should choose vitamin B_{12}-enriched cereals and other sources rich in this vitamin. Fermented plant products may contain some vitamin B_{12}, contributed by the bacteria responsible for fermenting. Much of the vitamin B_{12} 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] McLaren[29] 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-workers[32] 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, MacIntyre[33] 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 Africans[4] 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 intake[35] 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 THUSAstudy[37] 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, Heany[38] 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 B_{12}. 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, MacIntyre[33] 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 HDL_2-cholesterol concentrations, reduces triglyceride concentrations, as well as postprandial lipaemia and chilomicron 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 literature[50] on the protective effect of fish intake against coronary heart disease (CHD). In a systematic review of 11 prospective cohort studies, Marckmann and Grønbæck[51] 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-workers[52] 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.

Nestel[47] 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 Tanzania[54] 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-workers[45] 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. MacIntyre[33] 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 cholesterol[55] 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, McNamara[59] 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 McNamara[59]) failed to show an association between dietary cholesterol intake and CHD incidence.

The WCRF / AICR panel[53] 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 study[32] on urban black people from the Cape Peninsula, 88% of the sample consumed foods from the 'meat' group. The CORIS study[60] 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 meat[62] but possibly to the formation of heterocyclic amines during cooking.[63] However, the saturated fat content of meat, through its effects on total and LDLcholesterol concentrations, is generally accepted to increase risk of CHD. Breslow and co-workers[64] 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 study[67] 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-workers[69] 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. Sandstead[70] 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,[53] Munoz de Ch'avez and Ch'avez[71] 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.[3,4] 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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