# 10 The importance of the quality or type of fat in the diet: a food-based dietary guideline for South Africa

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## Abstract

The aim of this paper is to review the latest total fat intake data for South Africa, as well as scientific evidence on the effect of the total amount and quality or type of fat in the diet. The total fat intake of South Africans is within the goal of ≤ 30% of total energy, but the quality or type of fat in the diet requires attention. Fats are key nutrients required for early growth and development, and influence the body's response to nutrition-related noncommunicable diseases later in life. Based on the total fat intake data for South Africa, and the latest evidence on the unique properties of certain fatty acids for health and disease, revision of the previous food-based dietary guideline (FBDG), "Eat fat sparingly", was needed. "Use fats sparingly: choose vegetable oils, rather than hard fats" is the new FBDG formulated for the fat intake of South Africans. Replacing animal and plant sources of saturated fatty acids with polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids is recommended. The regular intake of oily fish to increase omega-3 long-chain PUFAs is important. Energy balance remains an important aspect, in addition to the composition of the diet. The FBDG "Use fats sparingly: choose vegetable oils rather than hard fats" is meant to convey a positive message, to ensure that the right types of fats and oils are eaten and used in food preparation for early development and long-term health. An alternative FBDG is: "Eat and use the right type of fats and oils in moderation".

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## Introduction

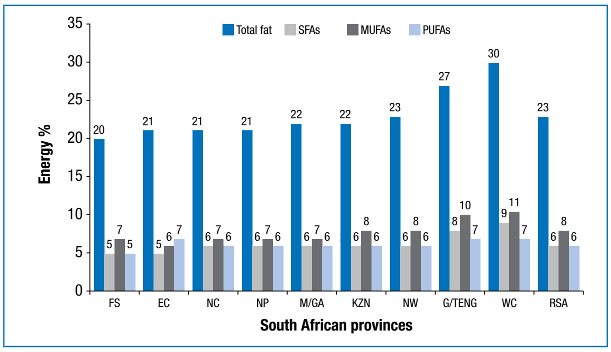
The original South African food-based dietary guideline (FBDG) for fat intake reads: "Eat fats sparingly". This FBDG was mainly aimed at people who followed or adopted a Western-type diet that was high in total fat, especially saturated fatty acids (SFAs), and who were at risk of developing cardiovascular disease and weight gain. The process to update the South African FBDGs is essential, as new scientific information on the food intake of South Africans has become available since the first set was published in 2001.[1] In addition, based on new research, several international organisations have published new dietary goals for fat and fatty acid intake. These organisations recommend a total fat intake of 30-35% of total energy (percentage of energy).[2,3] In South Africa, previously, this guideline was less than 30% energy.[1] Although the quantitative dietary goals always recommended that SFA intake should be reduced and that monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) should replace SFAs, the focus was on the total amount of fat consumed, rather than on the type of fatty acids. Today, there is a shift in this approach. The emphasis is on the type of fatty acids, rather than the total amount of fat, consumed. The importance of energy balance (i.e. energy intake and energy expenditure), was often overlooked as a result of the emphasis on lowering total fat intake. The impact of different individual fatty acids on health and disease is also better understood than it was previously. Dietary fats are not only a source of energy. The omega-3 (n-3) and omega-6 (n-6) fatty acids are essential nutrients that are involved in important physiological processes like brain development, while others affect the development of nutrition-related noncommunicable diseases later in life. In this narrative review, information on the fat intake of South Africans is provided, and the scientific basis for the importance of fat, especially the type of fat, in the diet is discussed. The new consensus FBDG formulated for South Africa is: "Use fats sparingly: choose vegetable oils rather than hard fats", while an alternative FBDG: "Eat and use the right type of fats and oils in moderation" is also proposed by the authors, especially for those at the lower end of total fat intake who do not require a lowering of total fat intake.

## Fat intake of South Africans

Dietary intake data collected before the previous FBDG was formulated indicated that there were different total fat intake patterns in South Africa. Parts of the population followed a diet with a total fat intake of > 30% energy.[1,4] Studies carried out in the Cape Peninsula in the early 1990s in black South Africans showed that total fat intake was moving towards 30% of energy.[5] Bourne[6] summarised data collected from African adults living in different rural areas of South Africa. The results showed that the percentage of energy from total fat varied between 17% and 26.5% of energy in the studies carried out between 1988 and 1992.

Since the previous set of FBDGs was published, a few cross-sectional studies have been undertaken to describe the dietary intakes of South Africans.[1] The National Food Consumption Survey (NFCS) of children aged 1-9 years was performed in 1999.[7] This study showed that the mean energy intake from total fat of the children in the study was 23% of energy. This ranged from 20-30% of energy in the nine provinces (Figure 1). It is important to note that in six of the nine provinces, the mean percentage of energy from total fat (20 - 22% of energy) was relatively low (Figure 1). The mean total fat intake was less than the country's mean of 23% of energy in these provinces. It is acknowledged that the data from the NFCS reflect the macronutrient composition of the diet of children aged 1-9 years. It does not necessarily reflect the composition of the diet of adults, but may provide some indication of the composition of the diet in the household. As the diets of children from several provinces showed that total fat intake was at the lower level of the recommendation in this regard, the previous FBDG, "Eat fats sparingly", may pose a risk, especially when recommended for infants, children and communities with a low fat intake.[1]

Cross-sectional studies were also carried out in selected groups of South Africans after the first set of FBDGs was published. The Transition and Health during Urbanisation of South Africans (THUSA) study and the Prospective Urban and Rural Epidemiology (PURE) study were among the major studies undertaken in adults. The THUSA study was carried out in adult black South African men and women in 1998 who were aged 16-65 years and living in the rural and urban areas of North West province.[8] The percentage of energy from total fat in the diets of those living in the rural areas was approximately 23% of energy, while in the urban areas it was 27.2% of energy in the men, and 28.8%




MUFAs: monounsaturated fatty acids, PUFAs: polyunsaturated fatty acids, SFAs: saturated fatty acids

**Figure 1:** Percentage of dietary energy from total fat, saturated, monounsaturated and polyunsaturated fatty acids in the nine provinces of South Africa and the mean for South Africa

of energy in the women (Table I). In the PURE study in black Africans aged 35-65 years from the North West province, it was also found that the percentage of energy from total fat was low in the rural areas: 17.6% and 22.6% of energy for men, and 20.3% and 24.1% of energy for women, in the 2005 and 2010 surveys respectively. In the urban areas, it was 25.3% and 26.2% of energy for men, and 28.3% and 27% of energy for women, in the 2005 and 2010 surveys respectively (Wentzel-Viljoen E, personal communication, November 2012). Vorster et al[9] demonstrated how total fat intake increased from 21% to 30% of energy in urban African women in South Africa, and from 15.5% to 21% of energy in rural African women from 1975-1996 to 2005. An increased intake of energy from total fat was observed in the urban areas, with figures approaching or already at the upper dietary goal. However, in 2005, the percentage of energy from total fat was still low, at 21% of energy in the rural areas.

The intake of SFAs varied at 3.9 - 9.1% of energy, MUFAs at 4.2 - 10.4% of energy, and PUFAs at 5.5 - 8.3% of energy (Table I). SFA intakes were not > 10% of energy in any of the reported studies. This is in contrast with data reported earlier in South Africans following a Western-type diet, where the percentage of energy from SFAs was approximately 13%.[14] Mean PUFA intakes were < 10% of energy, with some studies showing that the mean intake was < 6% of energy, the lower end of the range recommended for PUFA intake (Table I). The low PUFA intakes were especially applicable to those in whom the total fat intake was low (17.6-23.8% of energy from fat). Therefore, PUFA intake could be compromised if the intake of total fat is too low. The data reported in Table I mainly represent South Africans who do not follow a Western-type diet, and demonstrate that there are different dietary patterns in the country. This impacts on total fat and fatty acid intake.

## Foods that commonly contribute to fat intake in South African diets

There are limited data on the types of food consumed, especially for adults, and some of the data reported in this section for adults are dated, but are still used as an indication of the types of food consumed by South Africans.[15] Dietary intake data from the NFCS were used to identify the percentage of children who consumed food from fat-supplying food groups (Figures 2 and 3).

The milk group followed by the meat group in one- to five-year-old children, and the meat group followed by the milk group in six- to nine-year-old children, were the food groups from which foods were consumed by the highest percentage of children. Food from the vegetable fats and oil food group were ranked third in both age groups. The mean intakes of food commonly consumed by South Africans were reported in 2002 by Nel and

**Table I:** South African studies reporting dietary fat intake

| Reference | Study design | Gender | Sample size | Age (years) | Total fat | SFAs | MUFAs | PUFAs |
|---|---|---|---|---|---|---|---|---|
| | | | | | Mean (% energy) | | | |
| **Adults** | | | | | | | | |
| MacIntyre et al[8] (rural)* | Cross-sectional | Male | 431 | 15-65 | 23.3 | 6.6 | 7.2 | 5.5 |
| MacIntyre et al[8] (rural* | Cross-sectional | Female | 610 | 15-65 | 23.9 | 7.2 | 7.7 | 6.0 |
| Faber et al[10] (rural) | Cross-sectional | Female | 187 | 25-55 | 23.0 | Data unavailable | Data unavailable | Data unavailable |
| Wentzel-Viljoen[a] (rural)** | Prospective cohort | Male | 332 | 35-65 | 17.6 | 3.9 | 4.2 | 5.7 |
| Wentzel-Viljoen[a] (rural)** | Prospective cohort | Female | 634 | 35-65 | 20.3 | 4.5 | 4.7 | 6.9 |
| Wentzel-Viljoen[b] (rural)** | Prospective cohort | Male | 212 | 35-65 | 22.6 | 6.3 | 6.9 | 6.8 |
| Wentzel-Viljoen[b] (rural)** | Prospective cohort | Female | 469 | 35-65 | 24.1 | 6.7 | 7.0 | 7.7 |
| MacIntyre et al[8] (urban)* | Cross-sectional | Male | 312 | 15-65 | 27.2 | 7.7 | 9.4 | 6.3 |
| MacIntyre et al[8] (urban)* | Cross-sectional | Female | 398 | 15-65 | 28.8 | 9.0 | 10.4 | 6.7 |
| Wentzel-Viljoen[a] (urban)** | Prospective cohort | Male | 392 | 35-65 | 25.3 | 9.1 | 7.2 | 7.2 |
| Wentzel-Viljoen[a] (urban)** | Prospective cohort | Female | 592 | 35-65 | 28.3 | 7.3 | 8.2 | 8.3 |
| Wentzel-Viljoen[b] (urban)** | Prospective cohort | Male | 205 | 35-65 | 26.2 | 7.1 | 8.3 | 7.6 |
| Wentzel-Viljoen[b] (urban)** | Prospective cohort | Female | 367 | 35-65 | 27.0 | 7.4 | 8.8 | 8.1 |
| Steyn et al[11] (South Africa) | Cross-sectional | Female | 1726 | 15-49 | 23.8 | 6.7 | 8.1 | 5.7 |
| **Children** | | | | | | | | |
| Labadarios et al[12] (South Africa, rural) | Cross-sectional | Male, female | 603 | 1-9 | 21.0 | 5.5 | 6.7 | 6.0 |
| Labadarios et al[12] (South Africa, urban) | Cross-sectional | Male, female | 631 | 1-9 | 26.5 | 7.3 | 8.9 | 6.5 |
| Olewage-Theron et al[13] (informal) | Cross-sectional | Male, female | 478 | 6-13 | 26.8 | 7.3 | 8.2 | 8.0 |

MUFAs: monounsaturated fatty acids, PUFAs: polyunsaturated fatty acids, SFAs: saturated fatty acids
"Rural" is represented by people living in traditional African villages, farm dwellers and those in informal settlements
"Urban" is represented by both middle- and upper-class individuals (black South Africans)
* Transition and Health during Urbanisation of South Africans (THUSA) study. Weighted calculations were carried out
** Prospective Urban Rural Epidemiology (PURE) study. Black South Africans. (Wentzel-Viljoen E. Personal communication, November 2012)
[a] Data from 2005 survey; [b] Data from 2010 survey

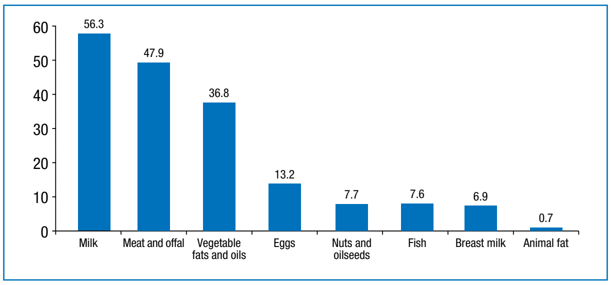



**Figure 2:** Main food groups supplying fats consumed by children aged 1-5 years[15] (n = 2 048)

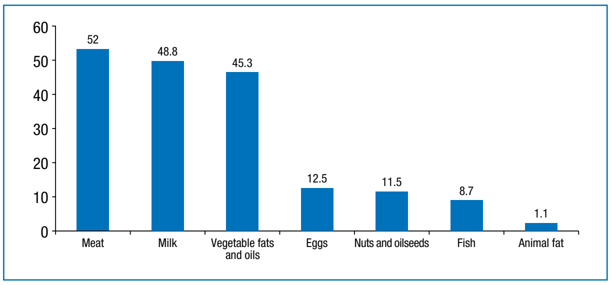



**Figure 3:** Main food groups supplying fats consumed by children aged 6-9 years[15] (n = 817)

Steyn.[15] These data provide some insight into the dietary intake of children and adults (10+ years).[16] Through a series of statistical techniques, the authors succeeded in estimating the usual food consumption of adults and children in rural and urban areas. In the age category 10+ years, individual surveys were included. The method of compiling the information did not take ethnic group proportions into consideration for each specific province. In agreement with data from the NFCS, it is shown that the food groups meat and offal, milk and vegetable fats and oil were also the most popular food groups from which fat-containing food items were consumed by this age category (Figure 4).

Food items are often sorted according to those that are most commonly consumed. The 10 food items that were mostly consumed and contributed to the fat intake of children participating in the NFCS and those aged 10+ years from the data reported by Nel and Steyn[15] are shown in Table II. In total, 15 food items were reported, six food items (i.e. full-cream milk, margarine (brick), chicken (meat), eggs (chicken), non-dairy creamers and peanut butter) appear in all three age categories, although their position in the top 10 differed. Full-cream milk appears at the top of the list for both age categories of children who participated in the NFCS, but for the age group 10+ years, non-dairy creamers appeared at the top of the list. The

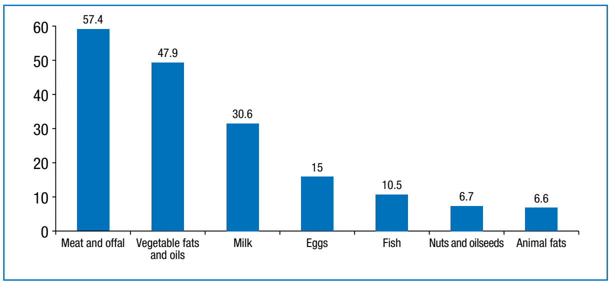



**Figure 4:** Main food groups supplying fats consumed by children and adults (10+ years) in South Africa[15]

latter is of special interest, as this food item often contains palm kernel oil, which is a rich source of the cholesterol-elevating SFAs and lauric and palmitic acids. Between 30.6% and 56.3% of South Africans consume food items from the milk group (Figures 2-4). The mean portion per person per day was 220 g in children aged 1-5 years, 207 g in children aged 6-9 years and 239 g in the age group 10+ years. Unfortunately, the data do not allow for a distinction between milk and other milk products (e.g. cheese), which makes it difficult to determine what contribution the milk group made to total fat and calcium intake in the different age groups, for example. In the age group 10+ years, full-cream milk was only fourth on the list of mostly consumed food items. The consumers of full-cream milk were relatively low, only 39%, 35% and 19% for the different age categories, 1-5 years, 6-9 years and 10+ years, respectively. Ful-cream milk is an important source of SFAs. The consumption of full-cream milk up to the age of at least two years is recommended in children.

Salty snacks featured at number eight in the youngest age category (Table II). Cookies, cakes and tarts only featured in the age category 6-9 years as one of the top 10 food items that contribute to fat intake. Protein-rich food (e.g. beef steak, fish and chicken heads and feet) were food items in the top 10 that contributed to fat intake in the oldest age category (10+ years).

## Fast food intake in South Africa

Fast foods are known to be generally high in energy and total fat, and some are also high in SFAs. A study was undertaken on a voluntary basis and, where possible, included a random sample of young adult South African citizens (19-30 years of age, n = 341) who visited selected shopping malls or similar complexes.[17] The sample represented different socio-economic groups in the city of Johannesburg.[17] One of the questions asked was whether or not participants "eat takeaway meals at least two to three times a month". Thirty-seven per cent of the total sample, 42.5% of those in the middle socio-economic group and 34.7% and 34.2% of those in the high and low socio-economic groups, respectively, answered positively.

Results from a nationally representative sample (n = 3 287) of South Africans also showed that approximately a third of the study population (32%) consumed fast foods 2-3 times a month or roughly once a week, while 6.8% consumed fast food two or more times a week.[18] The study on young adults showed that more people in the high socio-economic group (28%) consumed fast food once a week than those in the middle socio-economic

**Table II:** Top 10 foods, contributing to fat intake, which were consumed by the different age groups

| Food item | NFCS: age of 1-5 years (n = 2048)[15] | | NFCS: age of 6-9 years (n = 817)[15] | | Age of 10+ years (n = unknown)[15] | |
|---|---|---|---|---|---|---|
| | Number[*] | % consumers, amount (g) | Number[*] | % consumers, amount (g) | Number[*] | % consumers, amount (g) |
| Full-cream milk | 1 | 39 (186[**]) | 1 | 35 (171[**]) | 4 | 19 (204[**]) |
| Margarine (brick) | 2 | 24 (12[**]) | 2 | 30 (16[**]) | 2 | 21 (19[**]) |
| Chicken meat | 3 | 17 (61[**]) | 3 | 19 (80[**]) | 3 | 19 (111[**]) |
| Butter milk or *maas* (full cream) | 4 | 12 (306) | 7 | 9 (322) | - | - |
| Chicken eggs | 5 | 11 (70[**]) | 6 | 11 (80[**]) | 5 | 15 (99[**]) |
| Non-dairy creamers | 6 | 10 (7[**]) | 4 | 13 (7[**]) | 1 | 25 (6[**]) |
| Peanut butter | 7 | 8 (13[**]) | 5 | 11 (16[**]) | 10 | 6 (25[**]) |
| Salty snacks and maize | 8 | 7 (27) | | - | - | - |
| Chickens, stews and pies | 9 | 6 (111) | | - | - | - |
| Mincemeat dishes | 10 | 5 (61 ) | 8 | 8 (48) | - | - |
| Spread (medium or low fat) | | - | 9 | 8 (14) | 7 | 8 (15) |
| Cookies, cakes and tarts | | - | 10 | 7 (60) | - | - |
| Beef, steak, sirloin and fillet | | - | | - | 6 | 12 (140) |
| Fish | | - | | - | 8 | 6 (120) |
| Chicken (heads and feet) | | - | | - | 9 | 6 (80) |

NFCS: National Food Consumption Survey
* Ranking of the food item in the list of the top 10 food items that contribute to fat intake
** Food items that overlap between the three groups

**Table III:** The nutrient content of some typical fast food products

| | Regular hamburger* | Large hamburger 'quarter pounder'** | French fries (medium portion) | Milkshake | Regular hamburger* French fries, milkshake | Four seasons pizza (standard) |
|---|---|---|---|---|---|---|
| **Nutrient content*** ** | | | | | | |
| Energy (kJ) | 1 326 | 2 187 | 1 100 | 1 301 | 3 727 | 3 308 |
| Total fat (g) | 14 | 29 | 11 | 11 | 36 | 35 |
| SFAs (g) | 6 | 13 | 3 | 7 | 16 | 19 |
| % energy from fat | 39 | 49 | 37 | 31 | 36 | 39 |
| SFAs as % of total fat | 43 | 45 | 27 | 64 | 44 | 54 |
| **Contribution to 8 400 kJ diet****** | | | | | | |
| Energy (%) | 16 | 26 | 13 | 15 | 44 | 39 |
| Total fat (%) | 21 | 43 | 16 | 16 | 53 | 51 |
| SFAs (%) | 26 | 57 | 13 | 30 | 70 | 83 |

SFAs: saturated fatty acids
* The same hamburger was used for the calculations. It comprised one simple beef patty, cheese, no mayonnaise, pickles and condiments.
** This hamburger comprised a beef patty, cheese, pickles and condiments. Higher in energy than the regular burger.
*** Nutrient content from public domain websites of fast food outlets (14 November 2012). Weights of products not available.
**** 30% energy from fat = 68 g; 10% energy from SFAs = 23 g

(17.9%) and low socio-economic groups (16.2%). This finding is in agreement with the results from the national survey.[16,19] The participants who consumed fast foods daily constituted 10.9%, and of those, 56.8% were from the low socio-economic group.

Data on fast food intake were also collected from a consecutively selected sample of 655 black South Africans, 17.7 years of age, who participated in the Birth to Twenty study in Johannesburg.[19] Data were collected for the seven-day period preceding the study, and showed that 49.7% of the males and 38% of the females consumed fast foods more than eight times during this period. The consumption of fast food by the participants in the Birth to Twenty study was higher than that reported in the other study on young adults from Johannesburg, where only 10.9% reported an intake of takeaway meals daily.[17] The consumption of fast food 2-4 times and 5-7 times during this seven-day study period was reported by 20.2% and 29.8% of the study population, respectively. Only 5% of the males and 7.8% of the females consumed fast food 0-1 times during the seven-day study period.[19]

The most popular fast food items chosen by all three socio-economic groups in the study carried out in Johannesburg were burgers and pizza.[17] Fried chicken was the third most popular choice for the middle and low socio-economic groups, while it was French fries in the high socio-economic group. A "quarter", consisting of a quarter loaf of white bread, french fries, processed cheese with meat or sausages and fried egg and sauces, was the most popular fast food item (30.7%), followed by chips (21.8%), and *vetkoek* (12%), in the Birth to Ten Study.[19] The mean macronutrient content of a "quarter" was high: 5 369 kJ, 51.5 g fat and 12.9 g SFAs. In well-known commercial fast food outlets, one of the burgers (a beef patty, cheese, mayonnaise, condiments, lettuce, tomato and a white bun) provides 2 187 kJ, 29 g fat and 13 g SFAs (Table III).

Unfortunately, the South African studies which reported on fast food intake did not report on the contribution of fast food intake to the energy and fat intake of participants, which is a shortcoming. An example of the contribution that some fast food items would make to energy and fat intake is shown in Table III. Information on the contribution of these fast foods to the energy and fat intake of an 8 400 kJ diet is provided to illustrate the possible impact of fast food intake on energy and fat intake. This information supports the inclusion of consumer information in FBDG support material on the potential negative consequences of regular consumption of these foods.

It is clear that the contribution of fast foods to energy, total fat and SFAs plays a significant role, and FBDGs should recommend food choices that promote optimal nutritional intake. An effort should be made by dietitians, nutritionists and organisations that provide information on healthy eating patterns to encourage and empower formal and informal fast food outlets to offer clients healthier fast food choices.

## The literature on the role of fat in the diet

Traditionally, the nutritional role of fats in the diet was limited to their value as a good source of energy. The low-fat concept was introduced in an effort to decrease saturated fat intake. Less emphasis was placed on energy balance and the fact that the composition of the fat in the diet is of special importance. The discovery of the essential properties of certain fatty acids, and that they can influence growth and development, has provided reasons for this view to be amended.[2,3,20-22] Therefore, these specific fatty acids were classified as essential fatty acids (EFAs), as they cannot be synthesised by humans and need to be provided by the diet. Currently, only two dietary fatty acids are seen as essential, namely linoleic acid (LA) (C18:2n-6) from the n-6 PUFA family and $\alpha$-linolenic acid (ALA)(C18:3n-3) from the n-3 PUFA family. These fatty acids are also regarded as the parent fatty acids of the n-6 and n-3 PUFA families. Nutrition research has subsequently provided evidence in the last decade that has indicated the role of specific fatty acids with regard to cholesterol, lipoprotein and glucose metabolism, as well as insulin sensitivity.[23-25] It is recognised that the longer-chain metabolites of linoleic acid and α-linolenic acid are precursors for the formation of hormone-like substances called prostanoids, thromboxanes, leukotrienes and neuroprotectins that influence and regulate key physiological functions, ranging from blood pressure, vessel stiffness and relaxation, thrombotic aggregation and fibrinolytic activity, to inflammatory responses and leukocyte migration. These functions of linoleic acid and α-linolenic acid make them key nutrients.[26-28]

According to Uauy,[29] the interest in the quality of dietary fat or lipid supply as a major determinant of long-term health and well-being keeps on growing. The quality of dietary fat depends on the amount of the individual fatty acids present as part of total fat. As a result, the health implications of dietary fats are judged on their specific fatty acid content. Any fat or oil is classified according to the main proportions of either SFAs (mainly lauric, myristic, palmitic and stearic acids), MUFAs (mainly oleic acid) or PUFAs of the n-6 (linoleic and arachidonic acids) plus n-3 [α-linolenic acid, eicosapentaenoic (EPA), docosapentaenoic and docosahexaenoic acids (DHA)] series, and trans-fatty acid (elaidic and conjugated trans linoleic acids) present in the fat or oil. Therefore, any revised FBDG for fat and supporting information should place more emphasis on the quality, rather than the quantity, of dietary fat intake, to satisfy EFA needs, to promote neurodevelopment and cardiovascular health, and to prevent degenerative diseases at all stages of the life cycle.[29]

### Amount and type of fat in perspective

The 2008 Food and Agriculture Organization of the United Nations Expert Consultation on *Fats and Fatty Acids in Human Nutrition*[3] reviewed the latest evidence and concluded that the dietary recommendations for total fat, SFA, PUFA and trans-fatty acid intakes should be re-evaluated. This was based on numerous new population-based observational studies and controlled trials that contributed to clarifying the effects of dietary fats on health outcomes. Because of limited available dietary fat intake information in South Africa, the revised FBDG for fat will mostly rely on international recommendations, although all available national information was also considered. The latest most important evidence of the effect of the major dietary fatty acids on mostly chronic disease outcomes is briefly summarised here. As this subject has been reviewed extensively by several authors, information from review articles is reflected in many cases. Table IV provides a summary of convincing evidence on dietary fat intake and coronary heart disease, as adapted from Skeaff and Miller.[30]

### Total fat

According to Melanson et al,[31] there are obvious limitations to cross-sectional population studies, in that self-reported dietary intake data are used in the majority of these studies. In addition, causality cannot be concluded. Nevertheless, large sample sizes and overall consistency in the data have supported the hypothesis that higher total fat diets are associated with higher body weight.

Although several reports in the past have concluded that excessive dietary total fat consumption increases the risk of obesity, coronary heart disease and certain types of cancer, recent results from carefully performed prospective observational studies do not necessarily support the same sentiment. Smit et al[32] reported that these studies found no or small associations between dietary fat intake and obesity, weight gain, coronary disease and cancer.[33-37] It is well known that despite decreased intakes of total fat, obesity rates have increased.[38] This suggests that factors other than dietary fat may play a more important role in the increasing prevalence of obesity. Large-scale prospective cohort studies with repeated data have yielded mixed results. Both the Framingham studies[39] and the British National Diet and Nutrition Survey[40] indicated that irrespective of the decrease in percentage energy from total fat, the prevalence of obesity increased. However, in the National Health and Nutrition Examination Survey (NHANES I), the percentage of energy from fat was inversely related to weight change in women aged < 50 years, but was positively associated in men without any morbidity.[41] In a six-year follow-up study in Swedish women controlling total energy intake, total fat intake

**Table IV:** Summary of the effect of dietary fat on coronary heart disease[30]

| Type of fat | Fatal coronary heart disease | Coronary heart disease events |
|---|---|---|
| Trans-fatty acids | - | Convincing increased risk |
| PUFAs* for SFAs | Convincing decreased risk | Convincing decreased risk |
| n-3 long-chain PUFAs | - | Convincing decreased risk |
| Total fat | Convincing no relation | Convincing no relation |

CHD: coronary heart disease, n-3: omega 3, PUFAs: long-chain polyunsaturated fatty acids, SFA: saturated fatty acids
*: Includes both omega-6 and omega-3 polyunsaturated fatty acids

was only associated with increased weight in the sub-population defined as "predisposed", i.e. overweight at baseline and with an obese parent.[42] Conversely, in the Nurses' Health Study, the investigators found a weak relationship between baseline percentage energy from total fat and weight change, but no clear association with those "predisposed" to obesity.[37] On the other hand, in the Pound to Prevention prospective cohort study that included annual measurements over three years, dietary total fat (amount or percentage) showed a positive association with weight gain.[43] Melanson et al[31] concluded that, although prospective cohort studies have various strengths in terms of sample size, duration and the ability to evaluate the more chronic effects of diet, these data are inconclusive overall on the relationship between total fat intake and body weight.

Recent evidence from randomised controlled trials, in predominantly overweight populations from industrialised countries that compared isocaloric diets with different levels of total fat, demonstrated that the response to a diet with a high percentage of energy from total fat (40% of energy) did not differ from a diet with a low percentage of energy from total fat (20% of energy).[44] Conversely, the response can even lead to greater weight loss than that observed with low-fat diets.[45-47] Some controlled dietary studies indicated increased weight loss at one and two years with diets that were high in unsaturated fat,[48,50] or with low-fat, high-carbohydrate vegetarian diets.[50,51] A few meta-analyses of randomised controlled trials reported mixed results. Nordmann et al[52] reported that a low-carbohydrate (< 60 g carbohydrate per day) non-energy-restricted diet in terms of fat and protein intake appears to be at least as effective as low-fat, higher-carbohydrate, energy-restricted diets in inducing weight loss for up to one year. Lower fat diets (< 30% energy) are usually associated with lower total cholesterol and low-density lipoprotein (LDL) cholesterol levels,[44] but increased triacylglycerol and lowered high-density lipoprotein (HDL) cholesterol.[52] Many low-fat diets in studies are characterised by energy restriction, making interpretation of the effect on body weight very difficult. The Women's Health Initiative also supports the connection between lower fat intake and weight loss, although the study was based on cohorts designed to evaluate the prevention of cancer and cardiovascular diesease.[53] The intervention group received a much greater intensity of intervention than the control group, and although the outcome indicates weight loss, it is certainly insufficient for a definite conclusion to be drawn.[31]

In the Women's Health Trial Feasibility Study in Minority Populations, an overall lowering of dietary fat and total energy intake resulted in greater weight loss.[54] A meta-analysis of 16 trials concluded that comparing *ad libitum* low-fat diets with *ad libitum* habitual diets or moderate-fat diets resulted in more weight loss, especially in heavier subjects.[55] In a systematic review and meta-analysis of 33 randomised controlled trials (73 589 participants) and 10 cohort studies from developed countries only, Hooper et al[56] concluded that lower fat intake leads to a relatively small but significant and sustained reduction in body weight in adults, in studies with baseline fat intakes of 28-43% energy. The limitations in study design, lack of well-controlled studies and inconsistent findings on the relationship between total fat intake and body weight make a final conclusion difficult.[31] Furthermore, many studies are also characterised by nutrition education to improve eating habits and increase physical activity, making it difficult to draw conclusions about total fat intake on weight regulation.

**Saturated fatty acids**

Animal fats and vegetable oils (e.g. palm kernel and coconut oil), are solid at room temperature and are therefore often referred to as hard fats. SFAs will remain an integral part of the human diet, as they are present in all dietary fats and oils in different quantities. Although SFAs are associated with increased LDL cholesterol concentrations, Mensink et al[57] concluded that, because SFAs also raise HDL cholesterol and decrease triacylglycerol concentrations, they resulted in little net effect on the total cholesterol to HDL cholesterol ratio, compared with carbohydrates. In a recent meta-analysis of prospective epidemiological studies, the authors concluded that there was no significant evidence that SFAs are associated with an increased risk of coronary heart disease.[58] However, this report was criticised for containing several weaknesses. It was convincingly shown that by replacing SFAs with PUFAs, the risk for coronary heart disease was lowered in both prospective cohort studies[59] and randomised controlled trials.[60] Smit et al[32] stated that limiting SFA intake should be considered in the specific context of the nutrient that replaces it, as replacement with carbohydrates (particularly the easily digestible ones) may have little effect on serum lipids in reducing the risk of cardiovascular disease. Cognisance should also be taken that certain individual SFAs, like palmitic acid (C16:0), have more serum cholesterol-raising properties than lauric acid (C12:0).[61] On the other hand, stearic acid (C18:0) has been shown to have favourable effects on blood lipid profiles by significantly decreasing LDL cholesterol and factor VII coagulant activity in young men, compared to diets that are high in either lauric acid or palmitic acid.[62] In a study that compared stearic, oleic and linoleic acids (7% of energy) in young men and women with thrombotic tendency, stearic acid consumption reduced platelet volume relative to the other two fatty acids, but the effects on coagulation and fibrinolytic variables did not differ between the three groups.[63]

**Monounsaturated fatty acids**

Although some trials have indicated that the consumption of MUFAs has potential benefits on the blood lipid profile and cardiovascular disease risk factors,[57,64,65] prospective observational studies have failed to show associations,[59] and even higher risks of cardiovascular disease were observed after adjusting for age in the Nurses' Health Study.[66] It needs to be mentioned that the main source of MUFAs were of animal origin, and therefore the inclusion of trans-fatty acid in the sum of MUFAs in the analysis could have contributed towards this negative effect. In the pooled analysis of 11 cohort studies by Jakobsen et al, adjustment was done for trans-fatty acid intake in the studies with available information on trans-fatty acid intake, but that did not change the outcome on hazard ratios for cardiovascular disease.[59]

**Polyunsaturated fatty acids**

The quality of dietary fat is mainly determined by the proportions of specific PUFA it contains from both the n-6 and n-3 series. Apart from the role that EFAs play in human well-being, dietary EPA and DHA consumption has been demonstrated to have various physiological benefits on blood pressure, heart rate, triacylglycerol levels, inflammation and endothelial function. Consistent evidence of a reduced risk of fatal coronary heart disease and sudden cardiac death when consuming approximately 250 mg/day of EPA plus DHA has also been shown.[32]

DHA is the most abundant fatty acid in the brain and plays a major role in the development of the brain and retina of the foetus and young child, at least up to two years of age.[67-69] As the conversion from α-linolenic to DHA is very limited and may also vary depending on genetic polymorphisms of the FADS2 gene, it is recommended that preformed EPA and DHA are provided through the diet for optimal health at all stages of the life cycle.[70,71] DHA is regarded as conditionally essential during early development.[72-75] N-3 fatty acids are important during early growth and development. Convincing evidence indicates that an adequate intake for 0- to 6-month-old infants is 0.2-0.3% energy from α-linolenic and 0.1-0.18% energy from DHA.[3] This is based on the content of these fatty acids in breast milk. The recommended intake for infants aged 6-24 months is 0.4-0.6% energy from α-linolenic, while 10-12 mg/kg is a probable adequate intake level from DHA.[3] Although there is limited available information on the role of DHA in older children, two studies from South Africa (one of which is unpublished data) have indicated that there was a positive effect from DHA and EPA on the learning and memory of school-aged children.[76] In another study by Baumgartner et al[77] in children with poor iron and n-3 fatty acid status, DHA/EPA supplementation had no benefits on cognition and impaired working memory in anaemic children, and on long-term memory and retrieval in girls with iron deficiency.

**Trans-fatty acids**

There are two types of trans-fatty acids, namely industrially produced and or naturally occurring in food products from ruminants. Industrially produced trans-fatty acids are formed as a result of the partial hydrogenation of vegetable oils, while ruminant trans-fatty acids are produced by the bacterial metabolism of PUFAs in ruminants. The industrially produced trans-fatty acids are mostly found in some brands of margarine, spreads, bakery products, fast food, soup and sauce powders. Food labels should indicate the presence of partially hydrogenated vegetable oils as an ingredient in food. The trans-fatty acid content of food that contains partially hydrogenated vegetable oils is often much higher than the amount of ruminant-produced trans-fatty acid that is present in dairy and meat products.

In general, both previous and emerging evidence indicates that trans-fatty acid consumption has unique adverse effects, as it increases LDL cholesterol, lipoprotein(a) and apolipoprotein B (ApoB) concentrations, and is also responsible for lowering HDL cholestererol and ApoA1 concentrations. In addition, it is also associated with a higher risk of coronary heart disease.[64,78-80] Mozaffarian and Clarke[80] further concluded that the replacement of trans-fatty acid from partially hydrogenated vegetable oils with alternative fats and oils would substantially lower coronary heart disease risk, and that the discrepancies between estimates from controlled dietary trials versus prospective cohort studies could at least be partially explained by considering the effects of trans-fatty acids on multiple risk factors. They further concluded that food manufacturers, food services and restaurants should maximise overall health benefit by using replacement fats and oils with a higher content of cis-unsaturated fats.

Stender et al[81] concluded that on a gram-for-gram basis, industrially produced trans-fatty acids are more harmful and linked to an increased risk of coronary heart disease[82] than ruminant-produced trans-fatty acids. This is in accordance with the findings of Mozaffarian and Clark.[80] The conclusion is that controlled trials and observational studies have provided evidence that the consumption of trans-fatty acids from partially hydrogenated oils adversely affects several cardiovascular risk factors and contributes significantly to an increased risk of coronary heart disease events. Although ruminant trans-fatty acids cannot be removed entirely from the diet, their intake is already low in most populations and not significantly associated with coronary heart disease risk in several studies.[79] On the contrary, in a quantitative review by Brouwer et al,[83] it was concluded that all fatty acids with one or more bonds in the trans configuration raise the ratio of LDL to

HDL cholesterol, irrespective of their origin or structure. It was further argued that the results provide additional evidence, besides the high content of SFAs, to lower the intake of ruminant animal fats.

From a biochemical point of view, there may be enough reason to believe that both sources of trans-fatty acids (industrial- and ruminant-produced) compete with long-chain PUFAs during their incorporation into brain tissue.[81] Avoiding the introduction of these fatty acids in the diets of newborn infants during early development seems to be a prudent approach.

*The regulations relating to trans fat in foodstuffs,* No R 127, was published in the South African *Government Gazette*.[84] They state that any oil or fat intended for human consumption with a trans-fat content that "exceeds 2 g per 100 g of oil or fat is prohibited". To make a claim that the product is trans-fat free, the trans-fat content must be "less than 1 g per 100 g of the total fat or oil in the final product".[84] This new regulation on the trans-fatty acid content of food will make a significant contribution to lowering the intake of trans-fatty acids, especially industrially produced trans-fatty acids.

To summarise the literature on the role of fat intake, there are indications that total fat intake is less important than the type of fat in the diet. The reduction of trans-fatty acid seems to be especially important, as it increases LDL cholesterol concentrations and also lowers HDL cholesterol concentrations. Replacing SFAs with PUFAs decreases the risk of CHD.[85] However, it is important to acknowledge that many of the studies that have demonstrated a positive effect of PUFAs, did not distinguish between the different effects of n-6 and n-3 PUFAs on health outcomes.[86] There are indications from a recent, updated meta-analysis that substituting the most abundant n-6 PUFA, i.e. linoleic acid, for SFA, "increased the rates of death from all causes, coronary heart disease and CVD".[60] In this meta-analysis, recovered data from the Sydney Heart Study were analysed. It needs to be mentioned that the intervention group in this study was advised to increase its intake of PUFA intake, mainly from safflower oil and margarine, from 6% energy to 15% energy, reduce SFAs to less than 10% energy, and cholesterol intake to less than 300 mg per day. This intervention increased n-6 PUFA intakes without also increasing n-3 PUFA intakes. Therefore, the international n-6 PUFA guideline of not more than 5-8% energy seems to be important.[2] Increasing n-3 PUFA intake is essential to meet essential fatty acid and long-chain PUFA requirements. It is clear that dietary fat guidelines should emphasise the total fat intake, taking energy balance into account and ensuring that the optimal intake of the EFAs and the long-chain PUFAs are addressed. When diets are too low in fat, the essential fatty acid requirements and n-3 long-chain PUFA requirements may be compromised.

To improve the quality of fat intake, it is recommended that SFAs are replaced with PUFAs and MUFAs, rather than only concentrating on the lowering of total fat intake as a means of lowering SFA intake. Some South Africans who follow a high total-fat diet (> 35% energy), that is also high in energy, will need to pay attention to replacing SFA with PUFA and MUFA, and also lowering total fat intake in order to lower energy intake, and balance energy intake and energy expenditure. Cognisance should be taken when replacing SFA with PUFA that both n-6 and n-3 PUFAs are included as n-6 PUFA alone may be unlikely to provide the intended beneficial effects.[60] Therefore, the current international guideline supports the recommendation that the right amounts of n-6 (5-8% energy) and n-3 (1-2% energy) PUFAs are consumed to ensure that essential fatty acid requirements are met and that a more balanced n-6 and n-3 intake is ensured. Conversion of the quantitative dietary guidelines into the FBDGs is important if this goal is to be achieved.

## Quantitative dietary goals for fat intake

In February 2009, an international group of fatty acid experts met in Barcelona, Spain, to discuss the "health significance of fat quality in the diet". These experts decided to promote the notion of the health significance of fat quality in the diet.[87] At a meeting with the same theme in Cape Town in March 2009, a group of South African fatty acid and health scientists adapted the guideline for total fat intake and decided on a total fat intake guideline of < 30% energy for the country. They adopted a statement in line with the authoritative international health bodies and current evidence for the country.

The quantity (amount) and quality (type) of fat required for optimal health from the age of two years onwards are as follows:

- Total fat should provide 20-30% of the daily energy (≤ 30% energy) intake. The total amount of energy provided should be balanced between energy intake and energy expenditure. SFAs should provide no more than 10% energy intake, and the intake should be less than 7% energy in those at risk of CVD.
- PUFAs, including EFAs, should contribute 6-10% of energy, with n-6 providing 5-8% of energy and n-3, 1-2% of energy.
- The remainder of the energy from total fat should be provided by MUFAs.
- The intake of trans-fatty acids should be less than 1% of energy.

The recommendations for infants aged 0-2 years are that during the first six months of life, total dietary fat should provide 40-60% of energy. The aim is to sufficiently supply energy needed for growth and fat for tissue deposition.

**Table V:** Nutrient-based dietary guidelines for the intake of fat (calculated for an 8 400 kJ diet) and food-based dietary guidelines to meet nutrient goals

| Nutrient | Guideline | Fat (g) | Examples of food source |
|---|---|---|---|
| Total fat (% energy) | < 30 | 68 | All foods containing fat in their natural form, processed fat-containing foods, fried foods and salty snacks (e.g. potato crisps), and confectionery (sweets containing fat, e.g. chocolates and toffees) |
| SFAs (% energy) | < 10 | 23 | Animal fats (e.g. visible fat on meat, lard and dairy cream); vegetable fats (e.g. palm kernel, coconut and palm oil); and food products that have vegetable fats as an ingredient (e.g. non-dairy creamers) |
| TFAs (% energy) | < 1 | 2 | Industrially produced trans-fatty acids, (e.g. products that have partially hydrogenated oils as an ingredient) and naturally occurring trans-fatty acids (e.g. beef, lamb, butter, milk and other milk products) have small amounts |
| MUFAs (% energy) | ~10 (12) | 27 | Olive and canola oil and products made from these oils, avocado, nuts and meat |
| PUFAs (% energy) | 6 to < 10 (8) | 18 | Sunflower and soybean oil, and products made from these oils (e.g. soft-type margarines, mayonnaise and walnuts) |
| n-3 PUFAs (ALA) (% energy) | 0.6-1.2 | 1.4 – 2.7 | Green leafy vegetables, flaxseed oil and canola oil |
| n-3 EPA plus DHA (mg) | 250-500 | - | Fatty fish (e.g. pilchards, mackerel, salmon and sardines) |
| Cholesterol (mg) | < 300 | - | Organ meats (e.g. liver and kidneys), eggs and animal products |

ALA: alpha-linolenic acid, DHA: docosahexaenoic acid, EPA: eicosapentaenoic acid, MUFAs: monounsaturated fatty acids, n-3: omega-3, PUFAs: polyunsaturated fatty acids, SFAs: saturated fatty acids, TFAs: trans-fatty acids

This requirement is met by exclusive breastfeeding. Convincing evidence indicates that from 6-24 months of age, total fat intake should be reduced gradually to ~ 35% of energy, depending on the physical activity of the child.[3] The general recommendation is 30-35% of energy for children. If they are very active, higher intakes may be advisable.[3]

## The need to update the FBDG for fat

Based on the latest available fat intake data for South Africa and evidence from the current literature, especially the unique properties and effects of individual fatty acids in the diet on health, there was a need to revisit the previous FBDG for fat intake, i.e. “Eat fats sparingly”. It is necessary to emphasise the quality of fat in the diet. Therefore, the new consensus FBDG for South Africa is: “Use fats sparingly: choose vegetable oils rather than hard fats”, to both address the balance between intake (amount) and quality (vegetable oils versus hard fats). An alternative guideline proposed by the authors is: “Eat and use the right type of fats and oils in moderation”, especially to make provision for those at the lower end of total fat intake and those who do not require a lowering of total fat intake, but who need to improve the quality of fat in their diets.

## Food-based approach to meet the quantitative dietary goals for fat and fatty acid intake

The energy and nutrient goals formulated for South Africa and examples of foods that are important sources of total fat and specific fatty acids and cholesterol are shown in Table V. The food-based approach includes the recommendations discussed here.

In order to lower the intake of total fat, the consumption of all fat-containing foods, either as a natural part of the food, added preparation, or used in the production of food products, has to be decreased.

Important practices that achieve and maintain the optimal intake of SFAs include the use of low-fat milk and milk products instead of full-fat products, and consuming lean meat and chicken without the skin and fatty parts, instead of fatty meat and chicken.

Do not eat or frequently eat processed foods that contain plant oils and fats which are high in SFAs, e.g. palm kernel and coconut oil.

Consume fats and oils that are beneficial to health. Eat food that is high in PUFAs or MUFAs, and limit the intake of food that is high in SFAs.

Vegetable oils that are good sources of PUFAs and MUFAs, i.e. sunflower and canola oils, should be consumed. Food products which contain industrially produced, partially hydrogenated vegetable oils or fats should be avoided because of their trans-fat content. The ingredient list on food labels should indicate whether or not the product contains partially hydrogenated vegetable oils.

Include recommended types of fish regularly, to provide n-3 long-chain PUFAs, EPA and DHA. A daily intake of 250-500 mg of EPA and DHA is recommended. Table VI illustrates the EPA plus DHA content per 100 g of different types of fish. The number of times per week that a 100 g portion of fish should be consumed to provide approximately 500 mg of EPA plus DHA per day, as well as the amount of fish required per day to provide this amount of EPA plus DHA, is also shown. The introduction of fish early in the diet of children is recommended, to ensure that fish is consumed

**Table VI:** The eicosapentaenoic acid plus docosahexaenoic acid content and requirements of different fish species

| Type of fish | Amount (g) of EPA plus DHA per 100 g portion | Times/week 100 g portion should be consumed to provide ± 500 mg EPA plus DHA per day | Amount of fish (g) required per day to provide 500 mg EPA plus DHA |
|---|---|---|---|
| Mackerel[88] (salted) | 4.584 | 0.8 | 11 |
| Salmon, Atlantic[88*] | 2.147 | 1.6 | 23 |
| Herring, Atlantic[88*] | 2.014 | 1.7 | 25 |
| Bluefin tuna[88*] | 1.504 | 2.3 | 33 |
| Pilchards[89**] | 1.480 | 2.4 | 34 |
| Snoek[89] | 1.030 | 3.4 | 49 |
| Rainbow trout (wild)[88*] | 0.988 | 3.5 | 51 |
| Sardines[88***] | 0.982 | 3.6 | 51 |
| Hake (whiting)[88*] | 0.518 | 6.8 | 97 |
| Tuna (light)[88****] | 0.270 | 13 | 185 |

*cooked with dry heat, **Canned in brine, ***Canned in oil, drained solids, ****Canned in water

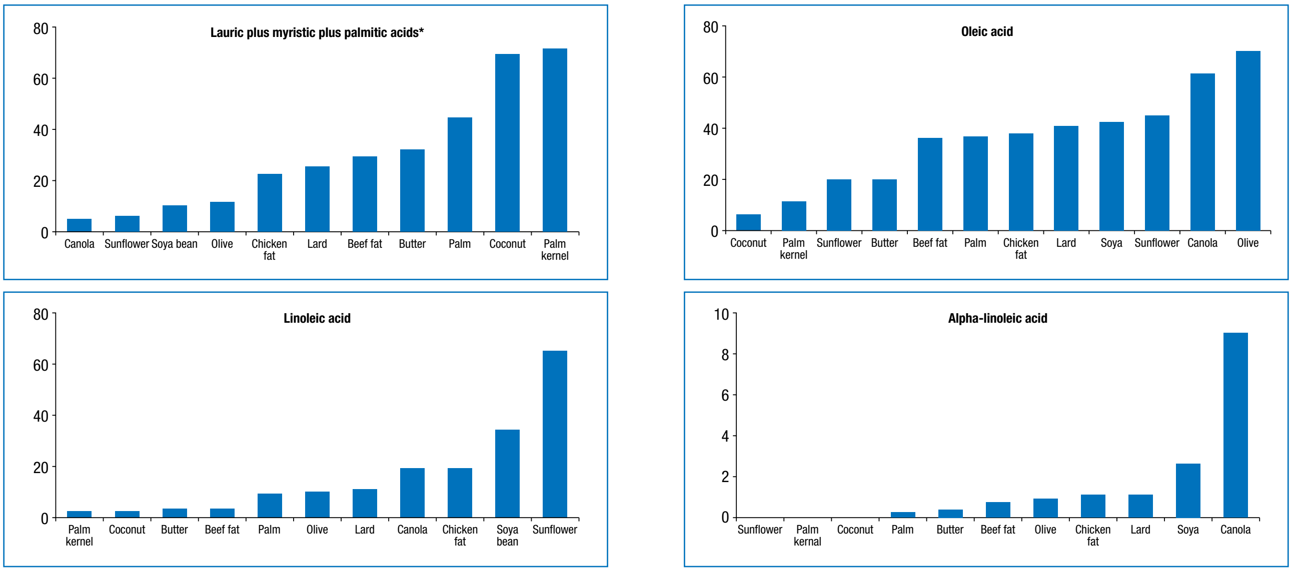



**Figure 5:** The fatty-acid composition of different vegetable oils and animal fats (g of fatty acid per 100 g oil or fat)
* Lauric, myristic and palmitic acids are the cholesterol-elevating fatty acids

on a regular basis throughout life.

A summary of the fatty acid composition of vegetable oils and animal fats is provided as a guideline for selecting the right type of fat (Figure 5).

## Conclusion

Current scientific evidence highlights the importance of the type of fat in the diet. Dietary fats are no longer seen merely as a good source of energy, but instead as an essential component of the human diet. They provide EFAs that are precursors of hormone-like substances that influence and regulate key physiological functions. The adequate intake of EFA, especially n-3 long-chain PUFAs, should be recommended to promote neurodevelopment and cardiovascular health, and to prevent degenerative diseases at all stages of the life cycle. Based on the strength of evidence from prospective and randomised trials, FBDGs on fat should emphasise the importance of the intake of certain fatty acids, rather than the total amount of fat in the human diet.

The available dietary intake data for South Africans indicate that there are pockets of the population where total fat intakes are at the lower end of the recommendation of 20-30% of energy. PUFA intake varies between 5.5% and 8.3% of energy at the lower end of the dietary intake goal, while information on n-3 PUFA intake is limited. The revised FBDG for fat intake recommends a moderate intake of total fat. Although fat is an important source of energy in the diet, the main message should be to balance energy intake with energy expenditure, in an effort to reach and maintain a normal body weight and to ensure that the type of fat consumed promotes health. Within the boundaries of energy intake and energy expenditure, the emphasis should be on the type, rather than on the amount, of fat in the diet. Educational material that will be used in South Africa to promote the FBDG on fat intake should place emphasis on the importance of the type of fat in the diet in order to compensate for this shortcoming in the present set of FBDGs.

More research and testing of an FBDG for fat intake, in which the importance of the type as well as the amount of fat is highlighted, is urgently required and recommended. The terms "hard" in the new statement consensus, and "moderation" in the alternative guideline proposed by the authors, should especially be consumer tested.

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