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Intake of Fatty Acids in General Populations Worldwide Does Not Meet Dietary Recommendations to Prevent Coronary Heart Disease: A Systematic Review of Data from 40 Countries

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Key Words

Dietary recommendations · Saturated fatty acids · Polyunsaturated fatty acids · Coronary heart disease

Abstract

Aim: To systematically review data from different countries on population intakes of total fat, saturated fatty acids (SFA) and polyunsaturated fatty acids (PUFA), and to compare these to recommendations from the Food and Agriculture Organization of the United Nations/the World Health Organization (FAO/WHO). ***Methods:*** Data from national dietary surveys or population studies published from 1995 were searched via MEDLINE, Web of Science and websites of national public health institutes. ***Results:*** Fatty acid intake data from 40 countries were included. Total fat intake ranged from 11.1 to 46.2 percent of energy intake (% E), SFA from 2.9 to 20.9% E and PUFA from 2.8 to 11.3% E. The mean intakes met the recommendation for total fat (20–35% E), SFA (<10% E) and PUFA (6–11% E) in 25, 11 and 20 countries, respectively. SFA intake correlated with total fat intake ($r = 0.76$, $p < 0.01$) but not with PUFA intake ($r = 0.03$, $p = 0.84$). Twenty-seven countries provided data on the distribution of fatty acids intake. In 18 of 27 countries, more than 50% of the population had SFA intakes >10% E and in 13 of 27 countries, the majority of the population had PUFA intakes <6% E. ***Conclusions:*** In many countries, the fatty acids intake of adults does not meet the levels that are recommended to prevent chronic diseases. The relation between SFA and PUFA intakes shows that lower intakes of SFA in the populations are not accompanied by higher intakes of PUFA, as is recommended for preventing coronary heart disease.

Introduction

Reducing saturated fatty acids (SFA) intake is a major focus of most dietary recommendations aiming to prevent chronic diseases including coronary heart disease (CHD). Dietary recommendations by the Food and Agriculture Organization of the United Nations/the World Health Organization (FAO/WHO) [1], Dietary Guidelines for Americans [2, 3] and the European Society of Cardiology [4] have set an upper limit of 10 percent of energy intake (% E) for total SFA intake; for the American Heart Association [5], this upper limit is 7% E. In addition, recent evidence indicates that SFA reduction alone is not enough to reduce the risk of coronary heart disease (CHD) [6]. There is strong, consistent evidence from randomized clin-

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ical trials [7], prospective cohort studies [8] and controlled metabolic studies on blood lipids [9] that reducing dietary SFA and trans fatty acids (TFA) and replacing them with polyunsaturated fatty acids (PUFA) reduces the risk of CHD [8, 10, 11]. Dietary PUFA include vegetable linoleic acid (LA) and alpha linolenic acid (ALA) including long chain PUFA (LCPUFA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) from marine sources. Therefore, most guidelines on dietary fats indicate that TFA intake should be minimized, consumption of fatty fish should be increased and that SFA should be replaced by (vegetable) PUFA. Recommendations are to consume <10% E as SFA and to consume 6–11% E as PUFA [1, 4, 12].

Despite the well-established fat and fatty acid guidelines, reliable data on their intakes in populations worldwide are scarce. In 2009, Elmadfa and Kornsteiner [12] reviewed fat and fatty acid intakes from 28 countries. They concluded that no general advice could be given for the improvement of fat intake worldwide due to differences in regional intakes. Since this review, new surveys from both developed and developing countries have been published, and international guidelines on fatty acid intakes in adults have been revised [1].

The primary objective of this study was to systematically review the available data on total fat, SFA and PUFA intakes in adults from different countries worldwide and to compare reported intake levels with the FAO/WHO-recommended intake levels to prevent CHD. The additional objective was to assess relations between intake levels of total fat, SFA and PUFA across countries.

Methods

Search Strategy

To retrieve information on dietary fat and fatty acid intakes in adults, a literature search in MEDLINE and Web of Science (from 1995 to March 2012) was conducted using the following search string: 'total fat', 'saturated fat*' or SAFA, 'polyunsaturated fat*' or PUFA, 'monounsaturated fat*' or MUFA and 'consumption' or 'intake' or 'survey' and 'adult*' or 'population' as words in the abstract. The reference lists of all articles of interest were checked for additional studies. No language restrictions were used. In addition to the MEDLINE and Web of Science literature search, national intake data were searched via the websites of national public health institutes.

After the initial search, all the publications and reports were screened to determine eligibility of data based on the following inclusion criteria: (1) national survey or population-based studies measuring dietary fatty acid intakes, (2) published later than 1995, (3) data from the general adult population (18–85 years), and (4) complete information provided on intake of total fat and the fatty acids SFA, monounsaturated fatty acids (MUFA) and PUFA and (5) a sample size ≥100. For countries where multiple datasets were available, data from the most recent national dietary surveys were included. If national dietary surveys were not available, representative data from population-based observational studies were used.

Dietary Recommendations for Intakes of Fatty Acids

The mean population intakes per country were compared to the recommended intake levels and ranges for total fat and fatty acids for adults as recently determined by the FAO/WHO [1]: total fat 20–35% E, SFA <10% E, PUFA 6–11% E, (2.5–9% E of which were omega-6 (LA) and 0.5–2% E were omega-3 fatty acids (ALA)), and EPA + DHA 0.250–2 g/day.

Data Extraction and Statistical Analysis

From each data source, we extracted the means and, when reported, standard deviations (SD) of intakes of total fat, SFA, MUFA and PUFA. Where fat and fatty acid intakes were expressed as absolute amounts (grams per day), values were converted to percentages of total energy intake using the conversion factor of 37.7 kJ/g for fat and fatty acid.

Where data were reported for subgroups (for example by age range or by gender), a weighted mean was calculated by weighing the mean intake of each subgroup by the number of the subjects in the subgroup. When SDs were not reported, they were calculated using the population sample size and reported standard error of mean (SEM).

The percentage of adults from each country deviating from the recommended intake for SFA and PUFA were estimated using the reported mean (μ) and SD, assuming a normal distribution of the data. The following formula was used to calculate z scores: z score = [X–μ]/SD. A normal distribution probability table [13] was used to derive the p values, i.e. the probability of deviating from the recommended intake or limit X, for example, 10% of SFA. This p value corresponding with limit X multiplied by 100 gives the percentage of the population that can be expected to be above or below limit X.

Pearson correlations between total fat, SFA and PUFA were computed. Statistical analyses were conducted using the Predictive Analytics software program (release 18.0.2, Chicago, Ill., USA).

Results

Availability of Data

The initial literature search yielded 651 publications and reports, 67 of which met the inclusion criteria for potentially eligible data sources (fig. 1). In a subsequent selection step, 24 data sources were excluded for the following reasons: (1) multiple surveys from the same country (n = 20; in these cases only the most recent data sets were used), (2) incomplete information on fatty acid intakes (n = 1), (3) surveys only reporting data of specific ethnic or minority groups in the population (n = 1), (4) studies that included diseased subjects (n = 1) and (5) a sample size <100 subjects (n = 1).

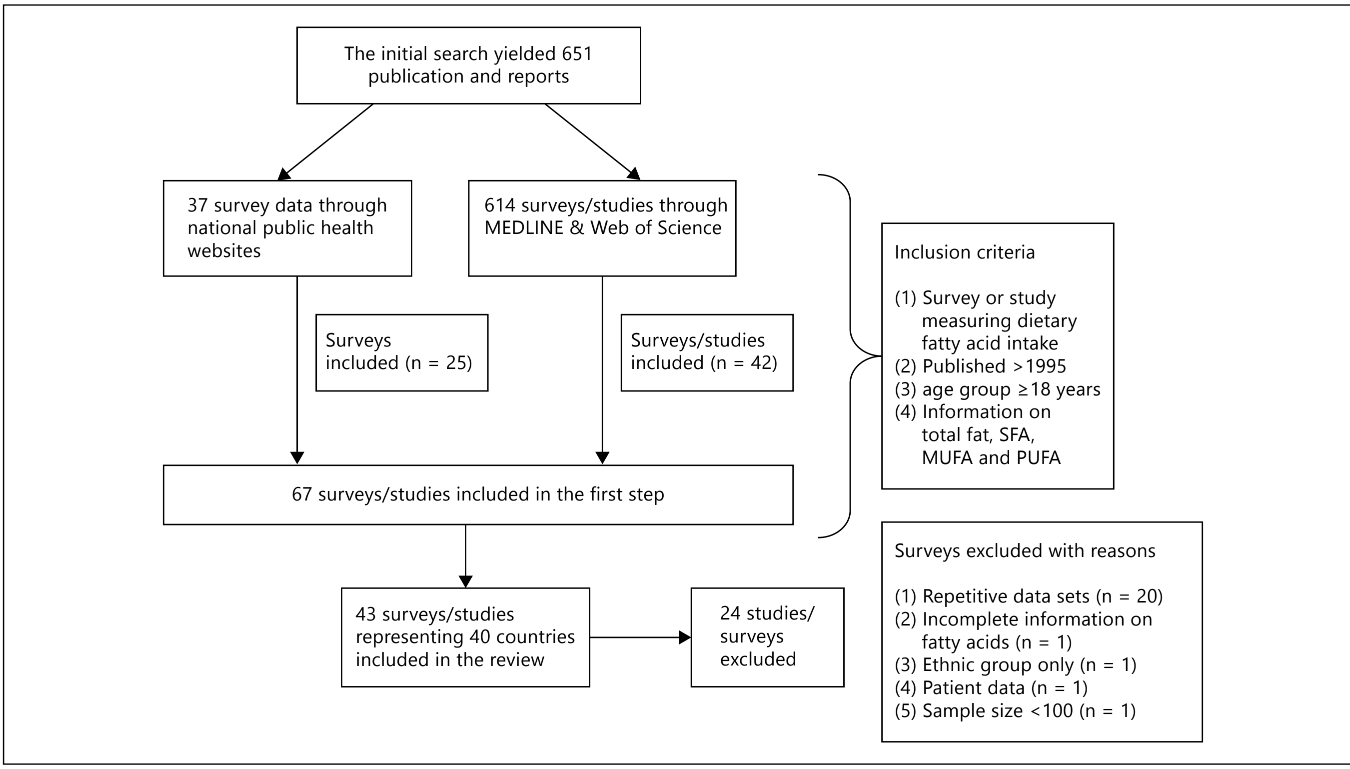

Fig. 1. Selection procedure and number of surveys and studies included and excluded from the review.

In total, 43 datasets met the inclusion criteria (fig. 1) representing 40 countries. For three countries, Australia, Belgium and Germany, two separate data sets reported intake data in SFA, MUFA and PUFA and data on omega-6/LA and omega-3/ALA. Details on surveys and studies included for review are given in table 1.

For 27 of 40 countries which provided information on distribution of the data, we could estimate the percentages of the population that failed to meet the recommended intakes for SFA and PUFA. For the remaining 13 countries (Austria, Australia, Cameroon, Finland, France, Indonesia, Japan, Netherlands, New Zealand, Norway, Slovakia, Slovenia and Spain), these could not be estimated because a SD or other measure of the population distribution was not reported.

Reported Intakes of Total Fat and Fatty Acids and Differences from Recommended Intake Levels

Total Fat

Mean intake of total fat ranged across countries from 11.1 to 46.2% E (table 1), with the lowest intake reported in Bangladesh and the highest intake reported in Greece. In 25 of the 40 countries, the mean total fat intakes were within the recommended range of 20–35% E. Of the remaining 15 countries, 14 had a mean total fat intake >35% E and one country had a mean total fat intake <20% E (Bangladesh: 11% E).

SFA

Mean intake of SFA ranged from 2.9 to 20.9% E across countries, with the lowest intake reported in Bangladesh and the highest intake in Indonesia (table 1). In 11 of the 40 countries, the mean SFA intakes were within the FAO/WHO recommended intake of <10% E (fig. 2).

In 18 of 27 countries for which we could estimate the population percentages deviating from recommended intakes, 50–96% of the population had SFA intakes >10% E (fig. 3). The percentage of population exceeding the recommended 10% E SFA intakes was lowest in five Asian countries: 0% for Bangladesh, 1% for China, 16% for Hong Kong, 16% for South Korea and 17% for India.

PUFA

Mean intakes of PUFA ranged from 2.8 to 11.3% E (table 1). In 20 of 40 countries, PUFA intakes were within the FAO/WHO recommended range of 6–11% E (fig. 2).

In 13 of 27 countries for which we could estimate the population percentages deviating from recommended in-

Table 1. Mean ± SD intakes of total fat, SFA, MUFA and PUFA among adults in 40 countries

Country and Reference	Year	Data source	Sample size	Dietary method	Energy, kJ Mean	Total fat, % E Mean ± SD	SFA, % E Mean ± SD	MUFA, % E Mean ± SD	PUFA, % E Mean ± SD
Australia [14]	1998	national nutrition survey	8,891	24-hour recall and FFQ	9,237	32.5	12.7	11.8	5.0
Austria [15]	2009	Austrian Nutrition Survey 2008	2,123	24-hour recall	8,242	37.0	14.5	12.5	8.0
Bangladesh* [16]	2004	prospective cohort study	189	7-day food diary	9,506	11.1±3.2	2.9±1.2	3.8±1.2	2.8±0.7
Belgium [17]	2006	Nutrition and Health (BIRNH) Survey	3,245	2 × 24-hour recall and FFQ	–	37.5±6.4	15.6±3.6	13.8±2.5	6.8±2.4
Bulgaria [18]	1998	national nutrition survey	860	24-hour recall	9,953	34.6±8.6	12.5±5.5	9.9±3.2	11.3±4.6
Cameroon [19]	2000	habitual diet study	1,785	FFQ	15,857	42.7	14.3	16.7	6.0
Canada [20]	2004	nutrition survey	18,820	24-hour recall	8,645	31.4±17.0	10.2±9.3	12.5±9.3	5.6±4.6
China [21]	2003	INTERMAP (cross-sectional) study	839	four 24-hour recall	8,583	20.0±6.1	5.0±2.0	8.1±2.8	5.8±2.2
Czech Republic [22]	2010	The HAPIEE study	7,913	FFQ	8,443	36.0±15.0	13.0±5.7	13.0±5.5	7.0±2.9
Denmark [23]	2010	national dietary survey	3,151	7-day food record	9,200	35.0±5.6	15.0±3.0	12.0±2.4	5.0±1.0
Finland [24]	2008	national nutrition survey	1,594	48-hour recall	7,917	32.1±7.6	13.5±4.4	12.4±3.7	6.2±2.4
France [25]	2004	dietary survey	1,089	7-day record	9,108	37.2	14.1	11.8	3.9
Germany [26]	2004	German Nutrition Survey	>1,000	written diet record	10,292	35.9	14.4	12.8	6.5
Greece [27]	2004	Greek EPIC cohort	20,942	FFQ	9,393	46.2±5.3	13.1±2.7	22.3±4.0	6.6±2.6
Guatemala [28]	2009	cross-sectional study	1,220	FFQ	12,422	22.6±7.0	9.1±4.2	7.7±2.1	4.3±0.9
Hong Kong [29]	1997	dietary survey in cardiovascular risk factor study	1,010	FFQ	8,853	29.0±5.5	8.0±2.0	10.2±5.6	6.5±1.5
Hungary [30]	2011	national dietary survey	3,077	3-day dietary record	10,263	37.5±5.5	10.7±2.4	11.3±2.7	8.9±2.2
India† [31]	2006	cross-sectional study	102	FFQ	10,903	22.5±6.9	7.2±2.9	8.7±2.5	6.6±2.1
Indonesia [32]	2005	cross-sectional study	1,430	24-hour recall	5,958	31.9	20.9	5.2	3.5
Ireland [33]	2008	food consumption survey	1,097	7-day food diary	–	35.8±5.4	14±3.1	12.0±2.0	7.0±2.1
Israel [34]	2001	MABAT First Israeli National Health and Nutrition Survey	3,242	24-hour recall and questionnaire	7,770	33.0±9.0	9.0±4.0	11.0±5.0	8.0±4.0
Italy [35]	2000	nutrition survey	1,461	7-day dietary record	10,292	35.0±6.0	10.6±2.4	12.8±3.6	4.8±2.2
Japan [36]	2004	national nutrition survey	>1,000	diet record and food weight record for 1 day	–	25.3	8.4	9.4	7.5
Malaysia [37]	2011	cross-sectional study	151	3-day dietary record	7,644	32.8±5.2	10.1±2.9	8.5±2.3	5.3±1.9
Mexico [38]	2011	Mexican Health and Nutrition Survey, 2006	16,366	FFQ	6,924	25.1±17.0	9.9±7.6	8.9±6.3	6.3±5.0
The Netherlands [39]	2011	Dutch National Food Consumption Survey	2,106	24-hour recalls	9,287	34.9	13.1	12.0	6.8
New Zealand [40]	2011	national nutrition survey	4,721	24-hour recall	9,096	33.7	13.1	12.4	4.9
Norway [41]	1997	Norwegian National Nutrition Surveys	2,672	FFQ	9,399	30.6	12.1	10.8	5.4
Poland [42]	2003	household food consumption survey	2,893	24-hour recall	–	35.7±8.1	11.6±4.1	15.4±4.5	5.2±2.4
Portugal [43]	1999	cross-sectional study	489	FFQ	9,690	28.5±5.0	8.9±2.4	12.4±2.4	4.9±1.1
Russia [22]	2010	The HAPIEE study	9,098	FFQ	10,790	43.0±15.0	14.0±6.2	16±6.1	9.0±3.5
Singapore [44]	2004	national nutrition survey	1,278	24-hour recall	10,033	29.6±10.0	11.2±3.5	9.8±3.6	5.6±3.5
Slovakia [45]	2002	two epidemiologic studies	4,018	24-hour recall	–	35.5	13.0	11.9	8.7
Slovenia [46]	1999	epidemiological study	2,183	FFQ	11,422	44.3	14.8	13.0	3.9
Spain [27]	2005	large studies (pooled analysis of studies) 1990–1998	10,208	24-hour diet, 3-day diet record and FFQ	9,142	38.5	12.0	15.9	5.6
South Africa‡ [47]	2002	cross-sectional study	292	validated quantitative FFQ	8,010	27.7±9.4	8.6±4.8	9.5±4.8	6.9±3.7
South Korea [48]	2004	dietary intake study	224	3-day dietary record	7,610	21.1±14.0	5.9±4.2	7.7±6.0	5.0±3.7
Sweden [49]	2005	national food survey	1,217	precoded 7-day food record questionnaire	8,891	34.0±5.0	14.5±2.5	12.5±2.0	4.7±1.4
UK [50]	2012	national diet and nutrition survey	434	4-day estimated food diary	7,543	32.9±7.0	12.0±3.4	11.7±3.0	5.9±2.0
USA [51]	2010	NHANES nutrition survey (2007–2008)	5,420	2 diet recall	8,903	34.0±14	11.0±7.3	12.5±7.3	7.0±7.3

* Only data reported with food diaries included.
† Only baseline data from FFQ1 included.
‡ Only data included from middle-class urban population.

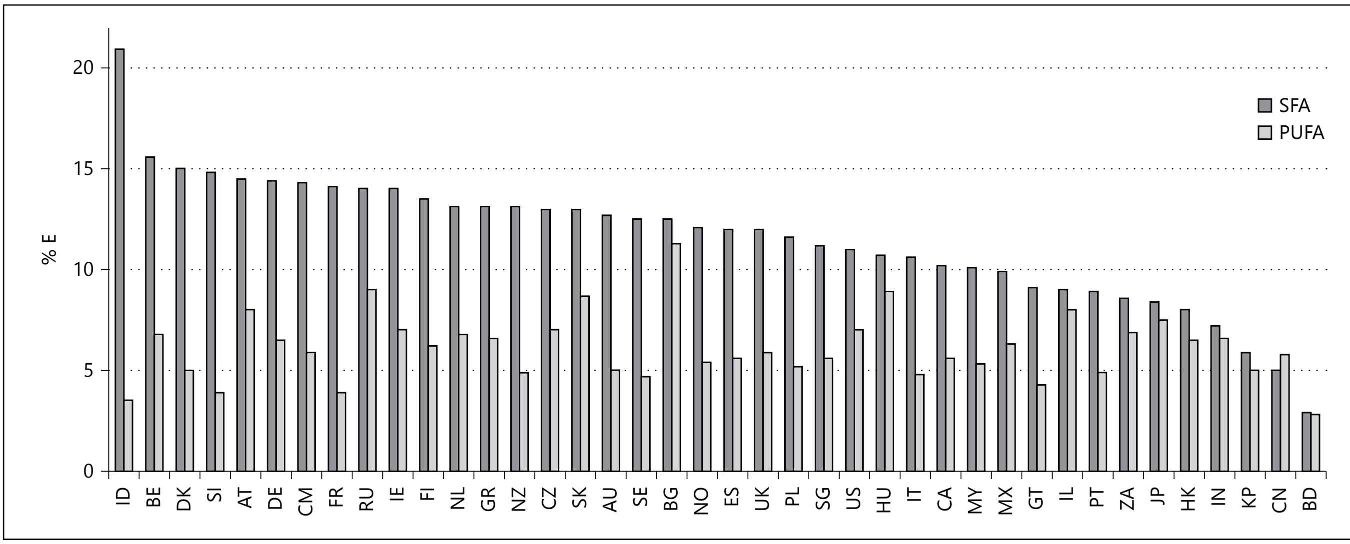

Fig. 2. Mean intake of SFA (intake in descending order) and PUFA in 40 countries. ID = Indonesia; BE = Belgium; DK = Denmark; SI = Slovenia; AT = Austria; DE = Germany; CM = Cameroon; FR = France; RU = Russia; IE = Ireland; FI = Finland; NL = Netherlands; GR = Greece; NZ = New Zealand; CZ = Czech Republic; SK = Slovakia; AU = Australia; SE = Sweden; BG = Bulgaria; NO = Norway; ES = Spain; UK = United Kingdom; PL = Poland; SG = Singapore; US = United States; HU = Hungary; IT = Italy; CA = Canada; MY = Malaysia; MX = Mexico; GT = Guatemala; IL = Israel; PT = Portugal; ZA = South Africa; JP = Japan; HK = Hong Kong; IN = India; KP = South Korea; CN = China; BD = Bangladesh.

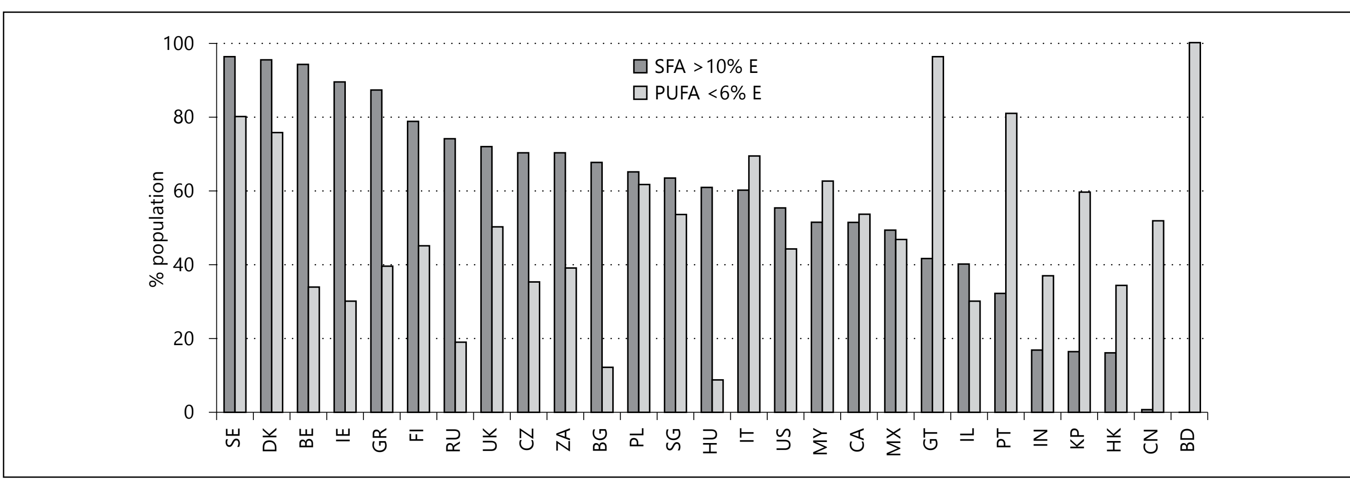

Fig. 3. Percentage of population consuming higher SFA (>10% E) and lower PUFA (<6% E) than recommended. SE = Sweden; DK = Denmark; BE = Belgium; IE = Ireland; GR = Greece; FI = Finland; RU = Russia; UK = United Kingdom; CZ = Czech Republic; ZA = South Africa; BG = Bulgaria; PL = Poland; SG = Singapore; HU = Hungary; IT = Italy; US = United States; MY = Malaysia; CA = Canada; MX = Mexico; GT = Guatemala; IL = Israel; PT = Portugal; IN = India; KP = South Korea; HK = Hong Kong; CN = China; BD = Bangladesh.

takes, 50–100% of the population had PUFA intakes that were <6% E (fig. 3). The percentage of population not reaching the recommended PUFA intake range was lowest in three European countries: 9% for Hungary, 12% for Bulgaria and 19% for Russia.

Separate Fatty Acids

For 15 of the 40 countries, additional data on omega-6/LA and omega-3/ALA were available as well as on LCPUFA, EPA and DHA for six countries (table 2). In this subset of countries, reported mean intakes of ALA

Table 2. Mean ± SD intakes of PUFA, LA, ALA, EPA and DHA in 15 countries

Country	Reference	PUFA, % E mean ± SD	LA, % E mean ± SD	ALA, % E mean ± SD	EPA, mg	DHA, mg
Australia	[52]	5.0	4.4	0.5	56	106
Belgium	[53, 54]	6.8±2.4	5.5±1.7	0.6±0.3		190
China	[21]	5.8±2.2	5.3±2.1	0.6±0.4	–	–
Finland	[24]	6.2±1.0	3.9±1.7	1.0±0.5	–	–
Germany	[55]	6.5	5.6	0.8	–	–
Hungary	[30]	8.9±2.2	8.6±3.2	0.3±0.2	–	–
Israel	[34]	8.0±4.0	7.4±5.8	0.8±0.8	–	–
Japan	[36]	7.5	6.1	0.8	42	64
Mexico	[38]	6.3±5.0	3.1±2.5	0.02±1.2	–	–
The Netherlands	[39]	6.8	5.6	0.7	178	
Slovakia	[45]	8.7	7.9	0.5	–	–
South Korea	[48]	5.0±3.7	4.0±3.1	0.4±0.6	215	204
Sweden	[49]	4.7±1.4	3.7	0.6	–	–
UK	[50]	5.9±2.0	4.9±1.5	1.0±0.5	–	–
USA	[51]	7.0±7.3	6.4±9.5	0.6±1.0	49	80

ranged from 0.02 to 1% E, and were within the recommended range of 0.5–2% E in all countries except for Mexico (0.02% E), Hungary (0.3% E) and South Korea (0.4% E). Mean intakes of LA ranged from 3.1 to 8.6% E, and intakes for all countries reporting data were within the recommended range of 2.5–9% E. Mean intakes of EPA plus DHA varied between 106 and 419 milligrams per day, and were below the recommended intake level of 250 mg/day in five of six countries (table 2).

Relationships between Intakes of Fat and Fatty Acids within Countries

Figure 4 shows the relationships between intakes of total fat, SFA and PUFA, based on their mean intakes in 40 countries. Total fat was significantly correlated with SFA intakes ($r = 0.76$, $p < 0.01$; fig. 4a) but not with PUFA intakes ($r = 0.27$, $p = 0.09$; fig. 4b). Intakes of SFA and PUFA were not correlated either ($r = 0.03$, $p = 0.84$; fig. 4c).

Discussion

This review demonstrates that in the majority of countries reporting fat and fatty acid intakes, the average SFA intake is higher than the recommended maximum of 10% E while in half of the countries, average PUFA intake is lower than the recommended range of 6–11% E. The lack of correlation between SFA and PUFA intakes across countries indicates that lower SFA intakes generally do not go together with higher PUFA intakes, the preferred replacement of SFA to prevent CHD.

Few papers have reported data on average fat and fatty acid intakes in different countries [12, 56, 57]. However, to our knowledge, our paper is the first to use a systematic approach to review the available data on fat intakes of different adult populations around the world, and to compare the reported intakes with the most recent recommended intake levels to prevent CHD [1]. In addition, our review addressed the population distributions of fatty acid intakes and the relations between intakes of total fat, SFA and PUFA at the population level. Several limitations of our analysis should be considered when interpreting the results within individual countries and making comparisons between countries. The main limitation is the heterogeneity of the available data sources with respect to the sampling and dietary assessment methods; this contributes to observed differences between countries. For example, national dietary surveys are the preferred type of research to estimate the distribution of nutrient intake in populations. These were available for the majority (24 out of 40) of the countries. However, it should be realized that national dietary surveys have limitations as well. Data from large observational studies were used for the remaining 16 countries. These data may not always be representative of national intakes, in particular for countries such as India and Malaysia where the data were based on a small sample size (<150) from one city only. Data for half of the countries in this review were based on weighed food records (for 3–7 days), multiple

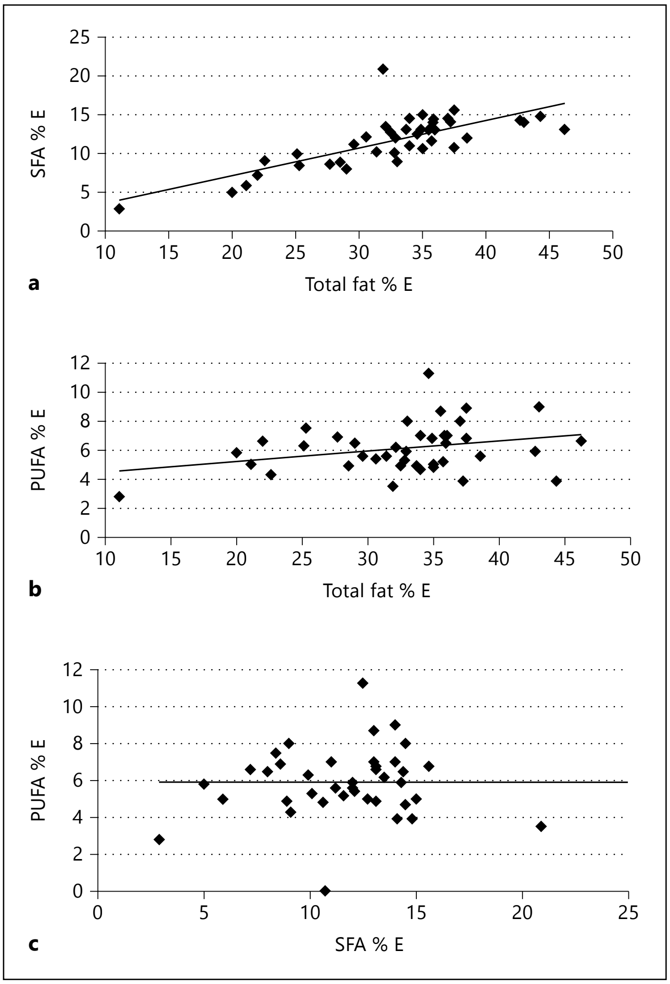

Fig. 4. Scatter plots on relationships between total fat and SFA intakes [$y = -0.10 + 0.35x$; $r^2 = 0.56$] (**a**), total fat and PUFA intakes [$y = 3.72 + 0.07x$; $r^2 = 0.09$] (**b**) and SFA and PUFA intakes [$y = 5.73 + 0.03x$; $r^2 = 0.00$] (**c**).

24-hour dietary recalls and 24-hour dietary recalls that were combined with food frequency questionnaires (FFQ). This combination of dietary assessment methods is considered more reliable for estimating the usual intake of foods in individuals than only single FFQs or 24-hour recalls [58–60], which were the basis for data from the remaining countries. Thus, we cannot exclude that differences in reported intakes between countries is partly due to differences in the data collection methods.

The second important limitation is incomplete information on specific fatty acids for some foods in local food composition tables [61], which could easily lead to underestimation of true intakes of SFA, MUFA or PUFA. For example, the sum of SFA, MUFA and PUFA is lower than that of total fat in 37 of 40 countries. Such differences are also found in other studies [12, 56, 57]. However, for 7 countries, this gap was larger than 5% E (Hungary, 5.2% E, Cameroon 5.8% E, France 7.4% E, Italy 6.8% E, Malaysia 8.9% E and Slovenia 12.6% E). A larger difference between total fat and the sum of SFA, MUFA and PUFA could indicate that a higher number of foods in the food composition table are without values for fatty acids. Therefore, results for total fat are more reliable than for separate fatty acid classes in these countries.

Third, fatty acid intakes data are reported for a limited number of countries worldwide. While data are available for most developed regions, much less data are available for Asia, Africa and South America.

Finally, we assumed a normal distribution of population intakes to estimate the percentages of adults not meeting the recommendations for SFA and PUFA. For developed countries, this seems a valid assumption because intakes of fat and fatty acids are usually normally distributed, even when there are differences in intakes between regions or socioeconomic strata [62, 63]. However, for developing countries such as India or Indonesia, the variability in fat intake can for a large part depend on the region and income level [32, 64, 65]. As a result, the distribution of the data may be skewed or bimodal in these countries. Thus, our estimations of the percentages of people deviating from recommended intake levels may be more reliable for developed countries than for developing countries. Because of these limitations, interpretation of results within individual countries and comparisons between countries should be made with care.

Our findings are consistent with earlier studies on fat and fatty acid intakes in adults [12, 56, 57] and children [66], indicating that in many countries, SFA intakes are higher and PUFA intakes are lower than recommended. Similarly, Elmadfa and Kornsteiner [12] showed that in 20 out of 28 countries worldwide, SFA intakes were higher than the recommended maximum intake of 10% E, and that PUFA intakes were lower than the recommended range of 6–11% E. High SFA and low PUFA intakes in Europe were also found in the TRANSFAIR study and in the European Prospective Investigation into Cancer and Nutrition study (EPIC) [56, 57]. TRANSFAIR reported SFA intakes ranging from 10 to 19% E and PUFA intakes ranging from 3 to 7% E [56] and EPIC reported SFA intakes of 9–16% E and PUFA intakes of 4–8% E in different countries [57].

The relatively large contribution of SFA to total energy in developed countries is likely due to high intakes of SFA-rich foods such as meat and dairy products [24, 40, 50, 67]. Our results show that a large percentage of the populations in Asian countries (Bangladesh, China, Hong Kong, South Korea and India) have SFA intakes below the recommended maximum of 10% E. These lower SFA intakes tend to go together with lower total fat intakes, as the variation in total fat intake explained more than half (56%) of the variance in SFA intake across countries. In contrast, mean PUFA intakes seem to be much less dependent on total fat intake (<10% of variance explained); they were at the lower end of the recommended range (6% E) in countries with the highest total fat intakes (>35% E) such as Spain, Slovenia and France. Thus, the differences in PUFA intakes between countries are apparently not driven by differences in total fat intakes, but more likely due to differences in local food habits and types and amounts of cooking oils and fats used. For example, greater use of sunflower oils in Bulgaria is known to contribute to the relatively high PUFA intake (in particular, linoleic acid) in this country [18]. On the other hand, the common use of butter and animal fats for cooking in many Western countries [67, 68], coconut oil in Indonesia and palm oil in Cameroon are important contributors to both low PUFA and high SFA intakes [19, 32]. Thus, it is likely that a major part of the variation in reported intakes between populations reflects the true underlying differences in intakes and type of fats and oils consumed.

Lowering the intake of SFA and replacing it with PUFA can have a substantial impact on the incidence of CHD in the population [7]. Practical examples of the public health impact are provided by experiences in Finland and Poland, where replacement of SFA by PUFA in the population has been associated with a significant decline in CHD mortality [69, 70]. However, our data show that a lower SFA intake does not necessarily go together with a higher PUFA intake, but is apparently compensated by higher intakes of other macronutrients. For example, in the USA, the contribution of total fat to energy intake decreased in the last decades but at the same time, the contribution of carbohydrates in the form of sugars and refined carbohydrates has increased, which does not confer benefit for CHD prevention [71, 72]. Public health messages and dietary policies should emphasize the replacement of SFA by PUFA instead of 'low-fat diet' or 'dietary fat should be consumed sparingly', as such messages may not guide the general population towards replacing SFA by PUFA [73] as is recommended by the FAO/WHO to prevent CHD [1].

Despite the general recognition of the importance of dietary fats in improving public health, our review shows that reliable data on intakes of fatty acid are scarce. Adequate data are needed to establish and support effective public health policies. This is of particular importance for developing countries, where diets are rapidly becoming more atherogenic, and the incidence of CHD is increasing [74].

In conclusion, the available data indicate that in many countries, adults have higher SFA and lower PUFA intakes than what is recommended. Lower intakes of SFA in the populations are not accompanied by higher intakes of PUFA, as recommended to prevent CHD. These data reinforce the need to focus public health campaigns on the replacement of foods and fats rich in SFA with those rich in PUFA, especially in countries with high SFA intakes. For developing countries with low total fat and SFA intakes, an increase in total fat intake should be in the form of PUFA rather than SFA.

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Disclosure Statement

RKH, MA, EA & PLZ are employees of Unilever. Unilever markets food products made of vegetable oils, including margarines and dressings.

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