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Dietary Fat Intake – A Global Perspective

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Key Words
Docosahexaenoic acid · Eicosapentaenoic acid · Fat intake · Fatty acids · Linoleic acid

Abstract
Background/Aim: The objective of this review was to collect data on the dietary intake of total fat and saturated (SFA), monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA), especially linoleic (LA), α-linolenic (ALA), eicosapentaenoic and docosahexaenoic fatty acids, in adults from various countries and to compare them with current recommendations for fat intake. ***Methods:*** Weighted mean intake data were collected from national dietary surveys, large cross-sectional studies and/or studies with focus on health and nutrition. Thereof, only studies with diet recalls, weighing records or food frequency questionnaires were considered. ***Results:*** Data from 28 countries were included, representing Africa (3), America (4), Asia (5), Australia/New Zealand (2) and Europe (14). Total fat intake ranged from 11.1 (China, Guangxi Bai Ku Yao and Han populations) to 50.7 (rural dwellers in Nigeria) percentages of total energy (%E). SFA intake varied from 3.1 (China, Guangxi Bai Ku Yao and Han populations) to 25.4%E (rural dwellers in Nigeria). Mean MUFA and PUFA intake ranged from 3.5 (China, Guangxi Bai Ku Yao and Han populations) to 22.3 (Greece), and 3.3 (India) to 11.3%E (Taiwan), respectively. The mean intake of LA and ALA was between 2.7 (India) and 7.2 (Austria), and 0.4 (France) and 1.0%E (Finland). ***Conclusion:*** With regard to recommendations for fat intake, no general advice for improvements can be given worldwide. Due to different dietary patterns, only regionally specific recommendations can be made about what would be necessary to modify and improve fat quantity and quality of the diet.

Introduction

Coronary heart disease (CHD) is a major contributor to morbidity and mortality worldwide. Risk factors are sedentary lifestyle, overweight/obesity, smoking, high blood pressure, raised total cholesterol, low-density-lipoprotein (LDL) cholesterol and triglycerides, as well as type 2 diabetes [1]. In brief, high intake of saturated (SFAs) and trans fatty acids (TFAs) as a percentage of total energy intake (%E) is known to correlate with CHD due to raised LDL cholesterol levels [2]. A recent pooled analysis of 11 cohort studies has suggested that replacing fatty acids (FAs) with polyunsaturated fatty acids (PUFAs) instead of monounsaturated fatty acids (MUFAs) or carbohydrates prevents coronary heart diseases [3]. However, the type of carbohydrate was not identified in this study [3]. In addition, it is also recognized that commercial foods labeled as 'low-fat/fat-free', which are high in refined carbohydrates and sugars, do not prevent the increasing trend towards obesity and type 2 diabetes [2]. Moreover, low-fat, high-carbohydrate diets are known to reduce the 'good' high-density lipoprotein (HDL) cholesterol and raise triglycerides. Both are associated with an

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increased CHD risk [4]. The results from the Nurses' Health Study demonstrated that replacing SFAs with unsaturated FAs was inversely related to the risk of CHD due to beneficial effects on blood lipids [4], whereas total fat intake was not significantly associated with the risk of CHD [4]. High consumption of linoleic acid (LA, 5–10%E) is regarded to reduce the risk of CHD, which is based on a lowered total/HDL cholesterol ratio [5]. This ratio is considered to be a more specific marker for CHD than LDL cholesterol levels [5]. A number of studies suggested that ALA seems to be similar to LA in decreasing LDL cholesterol levels [6]. In addition, there is also a low biosynthesis of eicosapentaenoic (EPA) and docosahexaenoic acid (DHA) from the parent essential ALA. Especially the intake of both EPA and DHA is inversely related to the risk of fatal (and possibly nonfatal) CHD. The protective tissue levels are reached by an intake of preformed EPA and DHA between 250 and 500 mg/day [7].

Due to different effects on health, the following recommendations for fat intake have been established. Intakes of total fat are recommended from 15 to 35%E, SFAs <10%E, TFAs <1%E and PUFAs from 6 to 10%E [8–10].

Methods

The objective of this review was to gather fat intake data for as many countries as possible to provide a global perspective. The intake data on fat quantity (total fat) and quality (SFAs, MUFAs and PUFAs) in adults were included. In this review, the fat intake data are based on estimates of food purchases and availability. The food balance sheets of the Food and Agricultural Organization of the United Nations (FAO) were excluded. They demonstrate only national trends and facilitate international comparisons. However, they are not suited to consider requirements and intakes with regard to age, sex and ethnic groups. Only individual dietary intake data calculated from 24-hour recalls, weighing records and food frequency questionnaires were included. Therefore, the collected data can only give a rough overview of fat intake in various countries, but are limited to direct comparisons due to the usage of different methods.

Only publications from the past 15 years were considered. Data were collected via internet and the electronic database PubMed between July 2008 and February 2009. The following key words were used: intake or diet of total fat, saturated fatty acids, polyunsaturated fatty acids, linoleic acid, α-linolenic acid, eicosapentaenoic acid, docosahexaenoic acid, essential fatty acids, omega–6 and omega–3 fatty acids, long-chain polyunsaturated fatty acids, and the name of the country included in title and abstract. The search strategy was limited to the English and German languages.

In most publications included in this review, results were presented as means. Some data had to be recalculated because they were given in absolute amounts; they were then related to and expressed as the percentage of fat energy in total energy intake (%E). When only the results of subgroups were presented, a weighted mean was used to give an overview for this country. This was done by weighting the mean fat intake of each subgroup by the number of individuals in the subgroup.

Results

Intake Data

Intake data were found for 28 countries. Three countries were from Africa, four from America, five from Asia, 14 from Europe and one each from Australia and New Zealand. All reports/publications provided data on total fat intake, SFAs, MUFAs and PUFAs, with the exception of Nigeria (only total fat and SFAs). An overview of the characteristics of the surveys found for each of the countries is presented in table 1. The data of 10 countries were obtained from the European Nutrition and Health Report 2004 [11], which included intake data on total fat, SFAs, MUFAs and PUFAs from mainly national dietary surveys. Fourteen countries provided additional specific data on LA and ALA, and for 12 countries intake data on EPA and DHA were available.

Fat Intake – A Global Perspective

Mean daily intake of total fat expressed as percentage of energy ranged from 11.1 to 50.7%E (table 1). The highest variation in total fat intake was observed in Africa (13.1–50.7%E). However, America (25.7–37.2%E), Asia (11.1–35.6%E) and Europe (28.5–46.2%E) also demonstrated great differences in regional fat intakes (table 2).

Total fat intake of 15 countries (Canada, Costa Rica, Mexico, US, China, India, Japan, South Korea, Australia, Finland, Italy, Norway, Portugal, Sweden and the UK) was between 20 and 35%E. Nine countries, the USA (Alaska), Taiwan, New Zealand, Austria, Denmark, France, Germany, Hungary and Spain, demonstrated high fat intakes (≥35%E). In addition, very high fat intakes (>40%E) were observed in Cameroon, Belgium, Nigeria and Greece, while total fat intake in China (Guangxi Bai Ku Yao and Han populations) and Tanzania is ≤15%E.

Eight countries had a lower SFA intake than 10%E, ranging from 3.1%E (China: Guangxi Bai Ku Yao and Han populations) to 9.5%E (Portugal). The remaining countries had a higher SFA intake (10.0–25.4%E) than the recommended <10%E [8, 10]. The highest SFA intake (25.4%E) was observed in rural dwellers in Northern Nigeria, whereas urban dwellers ate only 5.7%E of SFAs. The region comparison demonstrated that SFA intake was

Table 1. Overview of mean intakes (%E) of total fat, SFAs, MUFAs and PUFAs and characteristics of the surveys from various countries

Country and reference	Abbr.	Year of publ.	Data source	Sample size	Dietary method	Age group	Total fat, %E	SFA %E	MUFA %E	PUFA %E
Africa										
Cameroon [15]	CM	2000	habitual diet study of rural and urban subjects in Cameroon	1,785	24-hour recall and FFQ	24–74	42.8	14.1	16.4	5.9
Nigeria [16]	NG	2004	study of urban and rural dwellers in northern Nigeria	135 115	4 × 24-hour recalls and FFQ and 7 day dietary record	20–75	37.9 50.7	5.7 25.4	– –	– –
Tanzania [17]	TZ	1997	food consumption in rural and urban Tanzania	105	24-hour recall	35–44	13.1	4.1	4.7	4.0
America										
Canada [18]	CA	2004	nutrition survey, Canada excluding territories	18,820	24-hour recall	19+	31.4	10.2	12.5	5.6
Costa Rica [19]	CR	2002	comparison of dietary intakes in rural, suburban and urban populations	503	FFQ	~57	32.1	11.2	12.0	5.5
Mexico [20]	MX	in prep.	MHNS (Mexican Health an Nutrition Survey) 2006	15,951	FFQ (data are expressed as medians)	19–69	25.7	7.4	7.2	4.4
US [21] (a)	US (a)	2008	(NHANES) nutrition survey	4,423	2 × 24-hour recall	20+	33.7	11.3	12.4	7.1
US Alaska [22] (b)	US (b)	2005	GOCADAN (Genetics of Coronary Artery Disease in Alaska Natives) Study	734	FFQ (data are expressed as medians)	17–60	37.2	12.2	14.3	6.7
Asia										
China [23] (a)	CH (a)	2007	INTERMAP (International Study of Macro- and Mironutrients and Blood Pressure) Study	839	24-hour recall	~49	20.0	5.0	8.1	5.8
China [24] (b)	CH (b)	2007	dietary intake of Guangxi Bai Ku Yao and Han populations	2,343	24-hour recall	15–89	11.1	3.1	3.5	4.3
India [25]	IN	2005	survey, only women	200	3 × 24-hour recall		26.7	10.6	6.0	3.3
Japan [23]	JP (b)	2007	INTERMAP (International Study of Macro- and Miro- nutrients and Blood Pressure) Study	1,145	24-hour recall	~49	24.9	6.6	9.0	6.4
South Korea [26]	KR	2004	contribution of specific foods to fat and fatty acids	224	FFQ and 3-day dietary record	30–85	21.1	6.0	7.7	5.1
Taiwan [27]	TW	1994	government employees	423	24-hour recall	40–59	35.6	8.8	12.6	11.3
Australia										
Australia [28]	AU	1998	National Nutrition Survey	10,851	24-hour recall and FFQ	19+	32.5	12.7	11.8	5.0
New Zealand [29]	NZ	1999	National Nutrition Survey	4,636	24-hour recall and FFQ	15+	35.0	15.0	12.0	5.0
Europe										
Austria [30]	AT	2009	Austrian Nutrition Survey 2008	2,123	24-hour recall	19–64	37.3	14.6	12.6	8.0
Belgium [11]	BE	2005[1]	Survey 1979–1984	6,870	24-hour recall	25–75	41.5	16.5	15.0	8.5
Belgium [31]	BE	2006	Epidemiological Survey, only women	641	48-hour recall	18–39	34.3	13.7	13.1	6.0
Denmark [11]	DK	2005[1]	Survey 1995	1,352	7-day record	19–64	36.3	15.2	11.0	5.0
Finland [11]	FI	2005[1]	Survey 2002	2,007	48-hour recall	25–64	33.7	13.9	11.2	5.0
France [11]	FR	2005[1]	Survey 1994–2002	8,202	24-hour recall	35–60	38.2	15.6	14.0	5.0
Germany [32]	DE	2003	EPIC Cohort	4,021	24-hour recall	35–40	37.6	15.7	12.8	6.5
Greece [11] (a)	GR (a)	2005[1]	EPIC Cohort	20,942	FFQ	25–64	46.2	13.1	22.3	6.6
Greece [33] (Cretan) (b)	GR (b)	1999	food and nutrient intake of Cretan adults	470	validated 24-hour recall	18–64	40.3	11.8	19.8	5.1
Hungary [11]	HU	2005[1]	Survey 1992–1994	2,349	3 × 24-hour recall	18–54	37.9	14.0	15.0	4.0
Italy [11]	IT	2005[1]	Survey 1994–1996	–	7-day record	18–64	34.0	10.0	13.0	5.0
Norway [34]	NO	1998	Norwegian national nutrition surveys 1997	3,144	FFQ	19–79	31.0	12.2	10.9	5.5
Portugal [11] (a)	PT (a)	2005[1]	Surveys 1995–1998, 2001	972	FFQ	>18	30.1	9.5	12.9	5.3
Portugal [42] (b)	PT (b)	1999	assessment of food nutrient intakes	489	FFQ	>40	28.5	8.9	12.4	4.9
Spain [11] (a)	ES (a)	2005[1]	Survey 1990–1998	10,208	24-hour recalls, 3 day record FFQ	25–60	38.1	12.0	16.0	5.5
Spain [35] (Catalan) (b)	ES (b)	1999	Catalan Nutrition Survey	1,600	2 × 24-hour recall and FFQ	18–60	38.0	12.8	17.2	4.6
Sweden [11]	SE	2005[1]	National Food Survey 1997–1998	1,215	7-day record	18–74	34.0	14.5	12.5	5.0
UK [36]	UK	2003	National Diet and Nutrition Survey adults 19–64 years	1,724	7-day dietary record	19–64	33.5	12.6	11.1	6.0

TZ: SFA, MUFA and PUFA estimated and calculated from graphs. FFQ = Food frequency questionnaire.
[1] Data from the European Nutrition and Health Report 2004.

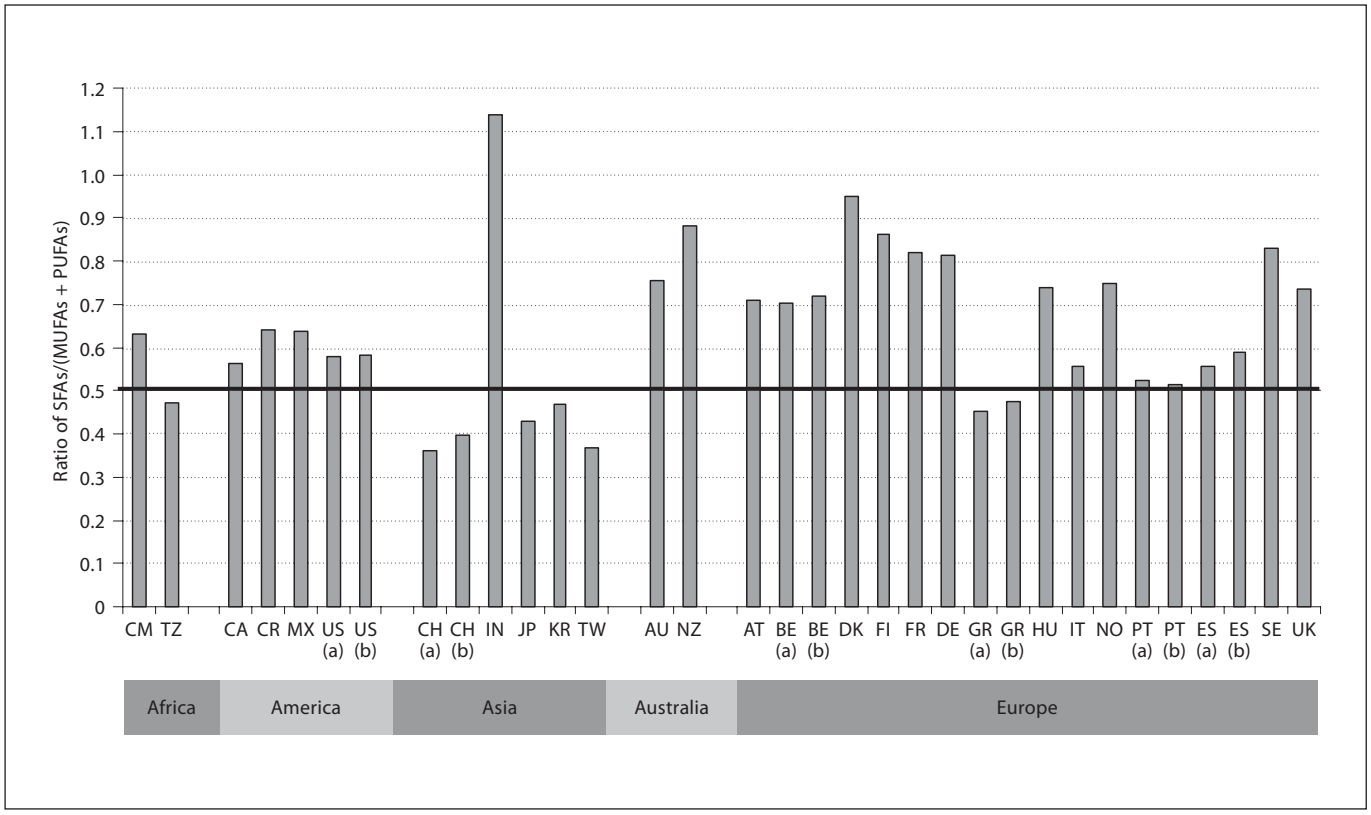

Fig. 1. Ratio of SFAs/(MUFAs + PUFAs) in the diet in different regions. For full country names and references, see table 1.

Table 2. Ranges of intake (%E) of total fat, SFA, MUFA and PUFA from different continents

Continents	Total fat	SFA	MUFA	PUFA
Africa	13.1–50.7	4.1–25.4	4.7–16.4	4.0–5.9
America	25.7–37.2	7.4–12.2	7.2–14.3	4.4–7.1
Asia	11.1–35.6	3.1–10.6	3.5–12.6	3.3–11.3
Australia	32.5–35.0	12.7–15.0	11.8–12.0	5.0
Europe	28.5–46.2	8.9–16.5	10.9–22.3	4.0–8.5

Africa (total fat and SFA: CM, NG and TZ; MUFA and PUFA: CM and TZ).

America (total fat, SFA, MUFA and PUFA: CA, CR, MX and US).

Asia (CH, IN, JP, KR and TW).

Australia (AU and NZ).

Europe (AT, BE, DK, FI, FR, DE, GR, HU, IT, NO, PT, ES, SE and UK).

The full country names and references are shown in table 1.

highest in European countries (11.8–16.5%E), with the exception of Portugal and Italy (≤10%E; table 1).

The average proportion of MUFAs was between 3.5 and 22.3%E. The mean daily intake of PUFAs in populations ranged from 3.3 (India) to 11.3%E (Taiwan). Twenty countries demonstrated mean intakes of PUFAs <6%E. The ratio of SFAs to the sum of MUFAs and PUFAs [SFAs/(MUFAs + PUFAs)] ranged from 0.36 (China) to 1.14 (India). A ratio >0.5 demonstrates that the proportion of SFAs is unfavorable, which could be observed in 21 countries (fig. 1).

Data on LA and ALA intake were limited to 14 countries (USA, Costa Rica, India, Japan, China, South Korea, Australia, Austria, Belgium, Finland, France, Germany, Sweden and the UK). Mean LA intake was between 2.7 (India) and 7.2%E (Austria). All countries demonstrated higher intakes than the 2.5%E of LA that are necessary to prevent deficiency symptoms [10], whereas 9/14 countries did not meet the WHO/FAO-recommended intake for n-6 (mainly LA) (5–8%E) [8] (fig. 2). Nine of 14 countries had mean ALA intakes of ≥0.5–1%E and five countries dem-

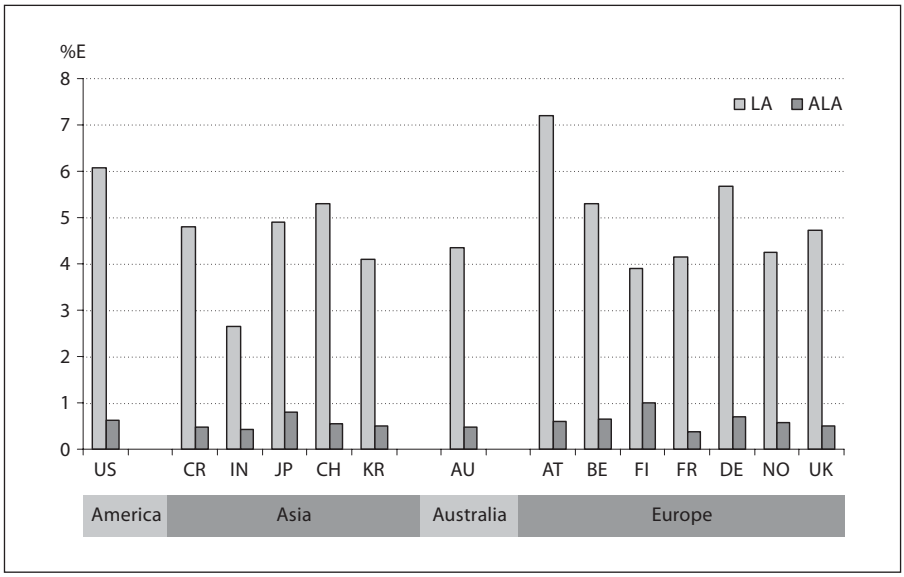

Fig. 2. Mean daily intake of LA and ALA among adults in various countries. For full country names, see table 1; US [37]; CR [19]; IN [25]; JP [23]; CH [23]; KR [26]; AU [38]; AT [30]; BE [31]; FI [39]; FR [40]; DE [32]; NO [34]; UK [41].

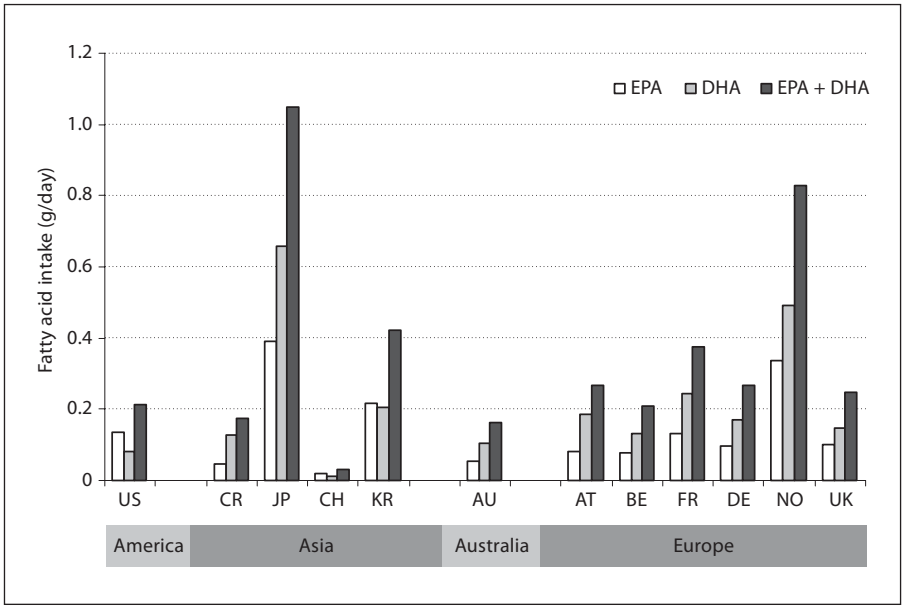

Fig. 3. Mean daily intake of EPA and DHA among adults in various countries. For full country names, see table 1; US [37]; CR [19]; JP [23]; CH [23]; KR [26]; AU [38]; AT [30]; BE [31]; FR [40]; DE [32]; NO [34]; UK [41].

onstrated very low intakes of ALA (<0.5%E), which is borderline when it comes to the prevention of deficiency symptoms [10]. The mean intake of EPA and DHA varied between 0.03 (China) and 1.05 g/day (Japan; fig. 3).

Discussion

Tremendous differences in total fat and FA intakes were observed between countries from different regions. For instance, 13 countries (Cameroon, Nigeria, US Alaska, Taiwan, Austria, Belgium, Denmark, France, Germany, Greece, Hungary, Spain and New Zealand) had total fat intakes ≥35%E, which is higher than recommended [8, 10]. Total fat intake of six countries was in agreement with the WHO/FAO nutrient intake goals (20–30%E) [8], including Mexico, China, India, Japan, South Korea and Portugal, while about nine countries were borderline (total fat intake between 30 and 35%E). It has to be emphasized that there is no uniform recommendation for this higher range of total fat intake between 30 and 35%E, especially in populations with a sedentary lifestyle [8–10,

12]. Total fat intake was even below the recommendation (≤15%E) [8] in China (Guangxi Bai Ku Yao and Han populations) and Tanzania.

The proportion of SFAs in total fat intake was higher than that of other FA groups in most countries in Europe, America (Mexico), Africa (Cameroon and Nigeria; rural dwellers), Asia (India), Australia and New Zealand. The highest intakes (≥14%E) of SFAs were reported in Cameroon, Nigeria, New Zealand, Austria, Belgium, Denmark, France, Germany, Hungary and Sweden. Only eight of 28 countries (Nigeria-urban, Tanzania, Mexico, China, Japan, South Korea, Taiwan and Portugal) had an SFA intake <10%E. SFAs, namely lauric, myristic and palmitic acids, are known to increase LDL cholesterol, which is a major risk factor for CHD [13]. Therefore, the upper level for SFA intake is set at 10%E [8].

The average percentage of MUFAs was between 3.5 and 22.3%E. The recommendation for MUFAs is calculated as total fat – (SFAs + PUFAs + TFAs) [11]. The replacement of SFAs and TFAs with cis-MUFAs and -PUFAs is negatively associated with CHD [4]. On the one hand, MUFAs are regarded as important FAs to improve the FA pattern by reducing SFAs and TFAs, but on the other hand this is not enough to change the quality of the fat intake when the total fat intake is very high (>35%E). For instance, Greece demonstrated a very high intake of MUFAs (22.3%E) and total fat intake (46.2%E; table 1), and although direct relationships between fat intake and body mass index have to be viewed with caution, a look at the data shows that the mean body mass index in Greek adults ranges from 25.4 (women, age group 25–34) to 30.3 (women, age group 55–64) [11].

All countries demonstrated higher intakes than 2.5%E of LA, which is sufficient to prevent deficiency symptoms. The majority (20) of the countries failed to reach the WHO/FAO population nutrient intake goals for PUFA intake (6–10%E) [11], which are important for the prevention of chronic diseases (table 1), especially in populations with borderline or even higher total fat intake (30–35%E). Mainly European countries, but also Australia and New Zealand, fit into this dietary pattern. Twenty countries demonstrated mean intakes of PUFAs <6%E. Due to the predominance of SFAs compared to unsaturated FAs, the calculated ratio of SFAs/(MUFAs + PUFAs) was unfavorable (>0.5) in 21 of the 28 countries. The borderline was set according to the general recommendations for fat and FAs (<10%E SFAs, 6–10%E PUFAs and the remaining from MUFAs 10–15%E) [8, 10]. Asia demonstrates a ratio <0.5 with the exception of India. Data from India are limited to women and are not representative for the whole population. Intake data for India are rare, but in 1998, Ghafoorunissa [14] reported that the fat intake in India varied considerably, which can be observed by widespread chronic energy deficiency related to low fat intake up to an increased risk of CHD in the urban middle- and high-income groups.

All countries demonstrated higher intakes than 2.5%E of LA. This level of intake is necessary to prevent deficiency symptoms [10]. In five countries, ALA intakes were well below <0.5%E, an intake level which is at the borderline to the prevention of deficiency symptoms [10], especially when the diet is lacking in n–3 long-chain PUFAs. Data on the mean intake of EPA and DHA were only available from 12 countries. The sum of both FAs varied between 0.03 (China) and 1.05 g/day (Japan; fig. 3).

Conclusion

Except for the fact that more accurate intake data are required to assess present global fat intake, available data indicate a very heterogeneous picture regarding current quantity and quality. Africa reveals a very high diversity in total fat, ranging from 13.1 to 50.1%E. In addition, these variations are not only found between countries in Africa, they are also found within a state (e.g. urban and rural dwellers in Northern Nigeria). Similar observations can be made for Asia, due to the fact that quantity and quality can differ hugely. All considered European countries mostly have high fat intakes (>35%E). Especially the intake of SFAs is high (>10%E). Therefore, the reduction in saturated fat (from animal products) would reduce both total fat and SFA intake, while the ratio of SFA to unsaturated FAs would be improved. Only Japan, South Korea and Norway demonstrate higher intakes of long-chain n–3 fatty acids (>0.4 g/day), which are recognized to have health benefits.

Disclosure Statement

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