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Is obesity related to the type of dietary fatty acids? An ecological study

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Abstract

Background: Animal studies and a few clinical trials lend credibility to the hypothesis that not all types of fatty acids carry the same potential for weight gain. Only a few epidemiological studies concerning this issue are currently available and results are conflicting.
Aim: The purpose of the present ecological study was to test the existence of an association between obesity prevalence and the types of fat available in 168 countries.
Methods: Data on the prevalence of obesity ($BMI \geq 30\,kg/m^2$) for women over 15 years of age were obtained from the WHO Global InfoBase. Food balance sheets for the years 1998 to 2002 were obtained from the FAOSTAT database. Five-year means for energy, total fat, MUFA, PUFA, SFA and 'other fat' per capita were calculated, with their standard deviations, for each country. Bivariate correlations and a multiple linear regression model were used to test for the association between prevalence of obesity and types of fat available in these countries.
Results: Not surprisingly, dietary energy supply, SFA, PUFA and 'other fat' were positively associated with the prevalence of obesity. We also found, however, a strong negative association between MUFA availability and obesity prevalence ($\beta = -0{\cdot}68$, $P < 0{\cdot}0001$).
Conclusion: Populations with a lower prevalence of obesity seem to consume a greater amount of MUFA. Considering the partial correlations between variables, our results suggest that in countries with higher obesity prevalence, it is the shift from MUFA to PUFA that particularly appears to be associated with the risk of obesity.

Keywords
Dietary fatty acids
Obesity
Ecological study

The prevalence of obesity has increased all over the world[1]. Obesity may lead to morbidity such as hypertension[2] and type 2 diabetes[3], and premature mortality[4,5]. Some authors have stated that dietary fat can contribute to obesity via passive over-consumption, because this macronutrient is less satiating than either carbohydrates or proteins[6] and is the most energy-dense macronutrient[6,7]. Recently, attention has been drawn to the type of fatty acids in the diet because of their differential metabolism, which is explained mostly by their chain length, saturation degree and stereoisomeric configuration[8–11]. Some investigators have proposed that dietary fat composition, independently of the amount of fat intake, can affect the development of obesity[8]. Authors have suggested that short- and medium-chain fatty acids have a higher oxidation rate[8–11] and may prevent obesity[11–13]. Others have reported that dietary MUFA[14,15], particularly oleic acid such as found in olive oil[16], and PUFA[17–19], especially those found in fish oil, may promote weight loss. Although outcomes are not always consistent[20–22], these results are reported mostly in animal studies and in a few clinical trials. Few studies in epidemiology concerning this issue are currently available and the results are conflicting[22–29]. To examine the general trend in the world on the relationship between type of fat available for human consumption and obesity, an ecological study was conducted. The purpose of the study was to test for the existence of an association between obesity prevalence and types of fat available in 168 countries.

Methods

An ecological study of 168 countries was conducted. Data on the prevalence of obesity ($BMI \geq 30\,kg/m^2$) among women aged 15 years and over were obtained from the WHO Global InfoBase[30]. Food balance sheets (FBS) for the years 1998 to 2002 were obtained from the FAOSTAT database[31]. Five-year averages for energy, total fat,

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MUFA, PUFA, SFA and 'other fat' per capita were calculated. The category 'other fat' is a category in the FBS regrouping all oils that have not been listed separately as other items. Their fatty acids content cannot therefore be estimated. We used the US Department of Agriculture Nutrient Data Laboratory database[32] and the Canadian Nutrient File[33] to derive fatty acids from the types of fat available for human consumption in each country. One hundred and sixty-eight countries were selected according to the availability of FBS in the FAOSTAT database and BMI percentage in the WHO website. According to FAOSTAT, the FBS presents a comprehensive picture of a country's food supply pattern during a specific period. For each food item the FBS shows what is potentially available for human consumption, referring to the sources of supply and utilisation. Furthermore, the FAOSTAT database also gives the per capita supply of each food item available for human consumption, obtained by dividing the respective quantity by the population actually consuming it. These 'per capita' figures refer to one-year availability of food supply. All data are presented as means with standard deviation. Spearman correlations between obesity prevalence and potential predictors (energy, total fat, PUFA, MUFA, SFA and 'other fat' in g/capita per d) were performed. To elucidate the relationship between the type of fat available in these countries and obesity prevalence we conducted multiple linear regression models. Statistical significance was accepted at the 5 % level. All analyses were performed using the Statistical Analysis Systems statistical software package version 8 (SAS Institute, Cary, NC, USA).

Results

The characteristics of the various countries are presented in the Appendix. The prevalence of obesity ranged from 0 % in Ethiopia to 49·2 % in Kuwait. There was a wide variation in total fat consumption, from 10·5 g/capita in Burundi to 159·1 g/capita in Belgium. Means and standard deviations for the variables studied, together with Spearman correlation coefficients for the association of dietary variables with the prevalence of obesity, are presented in Table 1. Significant positive correlations were observed between obesity prevalence and energy (0·48), total fat (0·51), MUFA (0·41), PUFA (0·43), SFA (0·45), and 'other fat' (0·41). Furthermore, the types of fat were correlated positively with each other, with energy and total fat, and all results were statistically significant. The contribution of each fat group is also presented in Table 1 as a percentage of total energy intake, since recommendations are often reported in such terms. Similarly to the absolute contributions, the percentage contribution of each type of fat also increased in countries with higher obesity prevalence, but the correlations, although all still significant, were weakened slightly.

Table 1 Mean and standard deviation of variables studied in 168 countries and Spearman correlations (ρ) between obesity prevalence and energy, total fat, SFA, MUFA, PUFA and 'other fat'

Variable	Mean	SD	ρ	P*
% obesity	16·1	16·1		
Energy (MJ)	11·23	2·10		
Energy (kcal)	2683	502	0·48	<0·0001
Total fat (g)	76·6	35·4	0·51	<0·0001
% energy from total fat	24·7	7·9	0·43	<0·0001
SFA (g)	25·5	13·9	0·45	<0·0001
% energy from SFA	8·2	3·7	0·36	<0·0001
MUFA (g)	23·4	13·7	0·41	<0·0001
% energy from MUFA	7·4	3·3	0·33	<0·0001
PUFA (g)	16·5	8·4	0·43	<0·0001
% energy from PUFA	5·4	2·2	0·37	<0·0001
Other fat (g)	11·5	5·3	0·41	<0·0001
% energy from other fat	3·7	1·5	0·27	<0·0003

*Correlations were considered significant at $P < 0·05$.

Table 2 Results of multiple linear regression analyses of dietary variables *v.* obesity prevalence (percentage of women in the population with BMI ≥ 30 kg/m^2) as dependent variable in 168 countries

Variable (per capita)	Adjusted regression coefficient	SE	P*
Energy (MJ)	0·007	0·003	0·02
SFA (g)	0·38	0·09	<0·0001
MUFA (g)	−0·68	0·13	<0·0001
PUFA (g)	0·68	0·15	<0·0001
Other fat (g)	0·44	0·18	0·02

$R^2 = 0·32$.
*Correlations were considered significant at $P < 0·05$.

We conducted multiple linear regression analyses to separate the relationships of each type of fat with obesity prevalence controlling for per capita energy intake. Note that the sum of all four types of fat (SFA, MUFA, PUFA and 'other') equals the total fat per capita and therefore this last variable was not included in the model. As expected, SFA ($\beta = 0·38$, $P < 0·0001$), PUFA ($\beta = 0·68$, $P < 0·0001$) and 'other fat' ($\beta = 0·44$, $P = 0·02$) were significantly positively associated with obesity. However, we found a significant negative association ($\beta = -0·68$, $P < 0·0001$) between MUFA availability and the prevalence of obesity (Table 2).

Discussion

The main result of the present paper is that, in spite of the significant positive association between obesity prevalence and total fat availability, MUFA availability is significantly negatively associated with the prevalence of obesity. It suggests that populations with lower obesity prevalence seem to consume greater amounts of MUFA, but such association cannot be taken as causal with our ecological study design. Nevertheless, this finding supports results from a few epidemiological studies reporting that the Mediterranean diet seems to be beneficial to weight loss[16,34,35]. In these studies, the authors specifically considered the consumption of olive oil, and not all types of MUFA in the diet. In contrast, other studies have reported that olive oil or the Mediterranean diet may promote weight gain[21,24,25]. Yet other investigators have not shown any relationship between a high consumption of MUFA and the prevalence of obesity[29,36,37]. Some clinical trials[15,38–41] but not all[21] have demonstrated that MUFA have a higher oxidation rate than SFA. In fact, the mechanism underlying this negative relationship, according to these studies, is that MUFA intake increases diet thermogenesis, which in turn stimulates the sympathetic nervous system[39], and abdominally obese subjects may be more responsive to stimulation of the sympathetic nervous system because they have an increased density and sensitivity of β-adrenoreceptors[42]. Similarly, some studies[43] in mice demonstrated that MUFA consumption might have an anti-obesity action. These authors reported that MUFA intake may stimulate fat utilisation through activation of the nuclear receptor, PPAR-α. Others[44] have demonstrated that rats with a high MUFA intake may gain weight.

Our multivariate model also suggests that, in countries with higher prevalence of obesity, dietary MUFA tend to give place to some SFA and more so to PUFA consumption. In fact, it has been reported that a high PUFA intake may promote weight gain[25,27]. When comparing eighty-eight children from Crete and Cyprus, two Mediterranean islands, regarding the association of adipose tissue arachidonic acid content with BMI and overweight status, Savva *et al.*[45] found higher mean levels of arachidonic acid, dihomo-γ-linolenic acid and DHA in overweight and obese children. A positive association between adipose tissue arachidonic acid and BMI was noted. On the other hand, Ailhaud *et al.*[46] reported that the inclusion of α-linolenic acid coming from PUFA in an isoenergetic diet rich in linoleic acid prevents increase of fat mass in pups. The authors highlighted that these data were consistent with their previous *in vitro* results comparing the adipogenic effect of *n*-6 PUFA and *n*-3 PUFA. Concerning SFA consumption and weight change, Doucet *et al.*[23] and Gonzalez *et al.*[25] reported a higher consumption of SFA in obese populations. Furthermore, some clinical trials[15,40] have demonstrated a higher oxidation rate in subjects who were consuming MUFA than in a group with SFA intake, for an isoenergetic diet. Kien *et al.*[15] suggested that a high SFA intake (palmitic acid) may increase the obesity rate. Sanders[47] demonstrated that populations with higher MUFA consumption tend to have lower intake of SFA, but we did not find such an association at the ecological level.

The present study has some positive points. First, the data on obesity prevalence were derived for all countries from the same recent WHO data set[30]. FBS were also derived from one online database, FAOSTAT. These FBS represent the pattern of a country's food supply during one year. Moreover, according to FAOSTAT, the quantity of foodstuff produced in a country added to the total quantity imported and adjusted to any change in stocks during a period of time gives the availability of supply during that period. These tables provide a useful reference for fat consumption for all countries[31].

For the statistical analysis we carried out multiple linear regression analyses to adjust for energy and estimate the respective contribution of each group of fats. This model explains 32 % of the variance found in the prevalence of obesity.

However, there are some limitations. Obviously, we cannot assume a negative cause-and-effect relationship between MUFA intake and obesity prevalence because the potential bias of ecological fallacy is always possible. This relationship may be totally or partially confounded by other unmeasured variables such as physical activity, geographical situation, consumption of dietary fibre, and fruit and vegetable intake. We are conscious of the fact that the FBS gives the food supply availability for the entire population in a country but obesity percentages taken into account in the present paper only include women aged 15 years and over. Consequently this relationship might be different for men, but the prevalence of obesity among men and women in a country is probably highly correlated. Another potential limitation is utilisation of the FBS, which is an estimation of the food supply available for human consumption in a given country, and that the validity of national reports may vary from country to country. The potential consequences of these variations in our analysis cannot be estimated. Also, the 'other fat' category that we had to use must have added imprecision to our estimates. An associated bias is nevertheless unlikely since its absolute contribution is small and represents probably a variety of fats. Finally, the availability for human consumption of more specific types of fatty acids and the *n*-6:*n*-3 ratio could not be taken into consideration for statistical analysis in the present paper, because of the imprecision and missing values of some particular items in the FBS.

This is the first ecological study to consider the type of fat and the prevalence of obesity in a large data set of 168 countries, since data on obesity from the WHO became available only recently. Our analysis suggests that additional studies on the potential role of MUFA in obesity are needed. Future use of online data sets is also encouraged.

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Appendix – Characteristics of 168 countries

Country	Obesity* (%)	Energy (MJ)	Energy (kcal)	Total fat (g)	SFA (g)	MUFA (g)	PUFA (g)	Other fat (g)
Albania	23·8	11·79	2818	83·4	29·5	22·4	19·4	12·1
Algeria	11·9	12·49	2986	69·2	15·9	20·3	24·1	8·9
Angola	5·9	8·41	2009	41·3	12·3	12·5	10·9	5·6
Antigua	21·5	9·68	2313	81·8	24·8	22·7	16·4	17·9
Argentina	27·1	13·04	3116	109·7	36·1	33·9	34·5	6·7
Armenia	19·8	9·18	2195	41·3	14·5	11·6	8·2	7·0
Australia	22·5	12·87	3077	133·6	48·8	50·4	18·7	16·2
Austria	20·4	15·58	3724	162·0	52·6	54·7	28·2	26·8
Azerbaijan	24·9	10·05	2403	38·4	15·6	11·7	7·3	3·8
Barbados	46·7	12·65	3024	98·3	28·4	27·9	19·4	22·6
Bahamas	25·6	11·19	2675	93·9	29·5	28·2	10·4	25·8
Bangladesh	0·1	9·46	2262	26·1	6·9	8·4	7·5	3·3
Belarus	32·2	12·77	3053	100·2	35·3	30·9	20·4	13·6
Belgium	9·5	15·08	3605	159·1	60·2	50·6	26·1	22·2
Belize	17·2	11·69	2795	67·3	22·3	21·0	10·0	14·0
Benin	6·2	10·44	2495	46·3	12·3	13·9	14·2	5·9
Bolivia	28·8	9·08	2169	54·0	13·7	15·8	16·1	8·4
Bosnia-Herzegovina	21·5	11·08	2649	56·3	17·8	16·4	11·9	10·2
Botswana	12·9	9·03	2158	50·9	13·9	11·7	14·8	10·5
Brazil	15·0	12·53	2995	91·0	29·1	26·8	26·0	7·4
Brunei Dar	25·9	11·89	2842	74·0	25·5	22·1	12·0	14·4
Bulgaria	19·0	11·76	2811	94·0	27·5	27·4	30·5	8·6
Burkina Faso	1·1	10·01	2393	53·0	11·5	17·4	16·1	8·0
Burundi	1·2	6·85	1638	10·5	2·4	2·1	2·6	3·4
Cambodia	0·1	8·36	1998	29·4	10·4	10·4	4·8	3·8
Cameroon	9·2	9·33	2231	45·7	14·1	13·1	10·0	8·5
Canada	22·2	14·77	3530	147·0	41·9	59·2	29·8	15·5
Cape Verde	11·0	13·36	3194	98·6	25·8	29·1	29·0	14·7
Czech Republic	20·0	13·16	3145	114·6	34·0	44·2	22·5	14·0
Central African Republic	1·1	8·10	1935	60·0	15·5	18·0	12·2	14·3
Chad	1·3	8·87	2121	66·6	12·6	25·5	16·6	11·9
Chile	27·2	11·84	2831	83·1	24·2	26·9	23·3	8·7
China	1·5	12·39	2962	84·1	24·1	32·7	18·6	8·5
Colombia	20·3	10·74	2567	65·3	25·4	19·9	12·8	7·2
Comoros	5·8	7·32	1750	40·1	28·0	4·9	2·9	4·3
Congo	2·7	8·41	2009	49·5	13·2	13·6	11·6	11·1
Democratic Republic of Congo	0·6	6·95	1660	26·7	8·4	8·1	4·5	5·7
Costa Rica	22·7	11·88	2839	76·0	28·5	22·2	16·8	8·5
Cuba	20·7	12·44	2973	50·6	17·6	14·6	14·2	4·2
Cote d'Ivore	4·8	10·94	2614	57·2	20·7	18·2	9·6	8·7
Croatia	15·4	11·39	2722	79·1	26·5	29·1	22·3	1·6
Cyprus	20·7	13·55	3238	128·9	37·6	43·3	28·3	19·6
Denmark	6·4	14·22	3399	137·8	54·1	49·1	22·1	14·3
Djibouti	5·0	8·90	2126	62·8	25·6	18·9	8·8	9·5
Dominica	41·8	11·48	2742	75·3	29·8	18·9	10·3	16·3
Dominican Republic	27·8	9·63	2301	80·5	26·3	21·3	24·3	8·6
Ecuador	15·4	11·37	2717	93·2	38·3	31·3	16·2	7·4
Egypt	39·3	13·98	3342	58·4	14·9	14·4	17·0	12·5
El Salvador	16·5	10·40	2486	57·1	18·8	15·6	15·0	7·7
Eritrea	0·1	6·42	1534	24·8	4·6	5·2	5·0	10·0

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Continued

Country	Obesity* (%)	Energy (MJ)	Energy (kcal)	Total fat (g)	SFA (g)	MUFA (g)	PUFA (g)	Other fat (g)
Estonia	8·4	12·95	3094	96·7	35·6	26·1	12·6	22·4
Ethiopia	0	7·49	1791	25·3	4·2	3·4	3·0	14·7
Fiji	29·8	12·03	2876	97·4	41·4	24·5	20·8	13·2
Finland	17·5	13·08	3127	124·3	46·4	45·3	16·5	15·2
France	6·1	15·13	3616	167·7	57·3	55·8	29·9	22·5
Gabon	24·5	10·95	2617	59·1	15·1	17·9	11·2	14·9
Gambia	1·9	9·48	2266	74·4	14·8	25·3	24·6	9·7
Germany	19·2	14·40	3442	144·8	50·5	47·3	24·7	20·0
Georgia	13·4	10·03	2398	45·0	14·5	11·6	8·7	10·2
Ghana	3·5	10·79	2578	38·5	8·3	7·1	3·4	19·7
Grenada	19·8	11·99	2865	101·1	36·0	22·8	15·8	26·5
Greece	23·4	15·36	3671	149·8	36·9	64·5	27·5	18·9
Guatemala	25·0	9·25	2211	47·0	11·3	12·2	15·5	8·0
Guinea	4·2	9·80	2343	54·9	16·2	19·0	11·6	8·1
Guinea-Bissau	2·4	8·69	2076	49·9	17·2	15·2	9·6	7·9
Guyana	15·6	11·20	2678	51·7	27·0	12·2	6·6	5·9
Haiti	8·2	8·64	2064	41·4	8·4	9·5	12·6	10·9
Honduras	13·1	9·87	2358	65·3	27·0	21·3	11·3	5·7
Hungary	16·1	14·31	3421	141·3	47·2	49·0	33·6	11·5
Iceland	22·0	13·33	3186	126·9	51·5	40·4	20·6	14·4
India	1·1	10·07	2406	49·5	16·2	14·2	10·4	8·7
Indonesia	2·0	12·03	2875	58·8	27·4	15·3	9·6	6·5
Iran	25·0	12·88	3079	61·4	16·1	14·4	20·4	11·7
Ireland	8·4	15·34	3666	135·4	55·3	47·7	21·9	10·8
Italy	12·2	15·38	3676	157·1	47·0	64·5	30·1	16·7
Jamaica	36·4	11·07	2646	73·3	24·4	19·0	20·7	9·2
Japan	1·5	11·65	2784	85·3	21·3	29·2	23·4	11·4
Jordan	40·2	11·08	2648	79·8	22·2	27·0	22·1	8·8
Kazakhstan	13·1	10·37	2479	69·5	23·0	18·5	13·9	14·1
Kenya	1·8	8·92	2131	48·7	18·4	14·8	8·7	6·8
Kiribati	37·9	11·80	2820	100·8	67·8	11·6	5·1	16·3
Korea	9·5	12·69	3034	74·2	20·7	21·0	22·5	10·1
Kuwait	49·2	12·82	3063	109·1	38·3	31·0	25·5	14·1
Kyrgyzstan	14·2	12·55	2999	54·3	22·0	15·6	8·6	8·1
Laos	9·2	9·47	2264	27·9	6·4	9·2	6·0	6·3
Latvia	15·0	12·24	2926	98·3	33·6	36·3	18·6	9·9
Lebanon	23·9	13·23	3162	112·6	25·9	31·6	29·8	25·3
Lesotho	33·2	10·84	2592	36·0	5·8	8·0	9·1	13·1
Liberia	9·6	8·54	2042	55·0	22·5	16·7	6·5	9·3
Libyan Arab Jamahiriya	21·1	13·87	3314	105·5	20·4	35·1	31·5	18·5
Lithuania	13·9	13·83	3306	91·7	29·4	30·6	16·8	14·9
Macedonia	24·3	11·45	2736	87·9	23·1	21·9	26·5	16·4
Madagascar	1·5	8·55	2043	29·6	7·4	9·0	5·8	7·4
Malawi	1·6	8·97	2143	29·7	5·2	8·5	9·9	6·1
Malaysia	6·8	12·03	2875	84·0	37·7	22·2	11·4	12·7
Maldives	20·2	10·55	2522	62·0	24·7	8·4	5·9	23·0
Moldova Republic	11·2	11·22	2682	52·1	13·4	11·8	15·0	11·9
Mali	3·4	9·30	2223	45·8	11·5	12·7	12·3	9·3
Malta	33·8	14·73	3520	111·8	40·2	37·5	20·4	16·6
Mauritania	20·6	11·54	2759	68·8	23·0	20·9	16·0	8·9
Mauritius	16·1	12·32	2945	82·9	21·6	21·4	29·7	10·6
Mexico	31·6	13·15	3142	86·4	25·1	25·2	22·6	14·5
Mongolia	24·6	9·14	2185	82·2	31·4	28·6	7·0	15·2
Morocco	19·0	12·82	3064	60·0	12·7	19·1	19·2	9·6
Mozambique	2·7	8·37	2000	33·4	9·2	8·1	10·1	6·0
Myanmar	8·0	11·93	2851	46·4	11·1	15·6	12·2	7·5
Namibia	4·9	9·18	2195	48·9	14·2	13·6	12·3	8·8
Nepal	0·2	9·98	2386	35·4	10·3	11·4	6·9	6·8
Netherlands	10·7	13·82	3304	143·7	55·7	46·1	24·7	17·0
New Zealand	26·7	13·41	3206	113·7	41·1	38·3	20·7	14·4
Nicaragua	28·3	9·48	2265	45·8	13·6	12·4	10·9	8·9
Niger	1·9	9·01	2154	37·2	10·0	11·5	9·7	6·0
Nigeria	4·9	11·41	2726	63·4	20·3	19·1	12·2	11·8
Norway	8·6	14·24	3404	139·8	50·2	45·5	28·1	14·4
Pakistan	2·9	10·20	2439	65·7	27·4	19·1	11·9	7·3
Panama	18·3	7·74	1850	68·3	21·9	20·5	17·0	8·9
Paraguay	15·8	10·64	2543	84·3	26·1	27·1	26·1	5·0
Peru	28·9	10·61	2535	46·5	13·7	12·4	14·9	6·3
Philippines	2·8	9·90	2366	47·3	21·6	15·7	6·7	3·3
Poland	18·0	14·08	3365	111·9	40·3	42·0	15·8	13·8

Continued

Country	Obesity* (%)	Energy (MJ)	Energy (kcal)	Total fat (g)	SFA (g)	MUFA (g)	PUFA (g)	Other fat (g)
Portugal	14·6	15·56	3719	137·8	46·0	48·7	25·9	17·2
Romania	12·0	14·10	3370	93·5	28·8	25·6	26·6	13·5
Russia	23·6	12·36	2954	78·9	26·8	23·4	22·0	7·5
Rwanda	1·2	8·13	1944	15·6	4·5	4·0	2·9	4·2
St Kitts & Nevis	22·0	10·96	2619	82·5	28·3	20·3	15·1	18·8
St Lucia	30·5	12·21	2918	79·0	35·7	23·5	9·4	10·4
St Vincent & Grenadines	17·8	10·31	2463	66·7	23·9	16·7	11·0	15·1
Samoa	55·0	11·77	2814	128·1	73·7	29·5	9·5	15·4
Sao Tome & Principe	3·7	9·75	2330	68·9	44·8	7·5	3·7	12·9
Saudi Arabia	32·8	11·86	2835	82·7	30·2	24·4	15·5	12·3
Senegal	7·8	9·50	2270	68·4	14·7	22·2	25·1	6·4
Serbia & Montenegro	20·6	11·60	2772	120·2	41·3	41·3	26·3	11·3
Sierra Leone	10·9	8·11	1939	46·6	19·6	14·4	6·5	6·1
Slovakia	21·3	12·26	2930	110·0	33·8	42·2	23·2	10·8
Slovenia	23·7	12·56	3003	105·8	36·0	34·3	22·3	13·2
Solomon Islands	13·4	10·21	2441	42·4	25·3	7·2	2·9	7·0
South Africa	34·3	12·06	2883	73·8	17·7	20·4	27·5	8·7
Spain	14·5	14·00	3345	150·0	39·0	58·3	37·3	16·5
Sri Lanka	0·1	9·92	2372	44·6	29·7	5·4	2·6	6·9
Sudan	4·3	9·56	2285	71·0	23·4	24·2	16·0	7·4
Sweden	10·0	13·10	3131	125·4	41·3	46·4	19·8	17·9
Swaziland	11·8	9·86	2357	45·4	12·7	11·7	8·8	12·2
Switzerland	16·4	14·20	3394	150·1	53·6	49·5	26·0	21·8
Syria	20·8	12·77	3051	103·9	27·1	29·5	24·8	22·5
Suriname	15·8	11·04	2638	68·9	21·2	18·5	23·8	5·4
Tajikistan	9·2	7·59	1815	35·4	10·0	7·8	12·8	4·8
Tanzania	2·8	8·14	1945	29·7	10·1	7·8	6·4	5·4
Thailand	7·0	10·03	2397	50·6	19·3	14·8	10·0	6·5
Timor Leste	14·2	11·15	2665	38·8	9·3	10·9	7·9	10·7
Togo	4·3	9·61	2298	44·8	15·4	12·4	10·4	4·6
Trinidad & Tobago	41·9	11·27	2693	73·7	26·0	19·9	20·8	8·0
Tunisia	28·8	13·84	3309	97·7	22·6	34·1	29·5	12·0
Turkey	32·1	14·05	3358	89·0	25·3	24·4	27·8	11·9
Turkmenistan	15·0	11·12	2657	70·4	24·7	19·0	18·7	8·0
Seychelles	35·8	10·22	2442	75·2	25·2	16·4	20·8	12·8
UAE	37·9	13·32	3184	96·6	32·7	27·4	20·3	17·8
Uganda	1·3	9·77	2335	31·4	7·5	10·1	7·9	5·9
UK	21·3	14·17	3386	144·8	45·6	54·8	26·3	13·6
Ukraine	19·4	12·17	2909	74·1	24·2	21·0	21·0	7·9
Uruguay	19·6	11·82	2826	93·7	28·5	30·9	19·7	14·7
USA	37·8	15·69	3751	152·2	43·5	45·9	47·2	13·9
Uzbekistan	13·5	9·83	2349	66·4	22·3	16·6	20·5	7·0
Venezuela	22·4	9·97	2383	67·7	18·3	19·6	22·6	7·2
Vanuatu	23·4	10·71	2559	89·0	48·3	19·0	7·5	14·2
Vietnam	0·2	10·48	2504	41·5	14·1	14·8	6·2	6·4
Yemen	4·4	8·51	2034	38·8	14·0	11·8	8·3	4·7
Zambia	1·6	7·92	1892	30·8	6·0	8·4	11·0	5·4
Zimbabwe	14·1	8·44	2017	52·7	12·3	15·9	19·3	5·2

Total fat, MUFA, PUFA, SFA and other fat represent all the quantities of fat available for human consumption per capita.
*Obesity prevalence is the percentage of women with BMI $\geq 30\,kg/m^2$ in the population of each country.

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