ORIGINAL RESEARCH

Trends in Fatty Acid Intake of Adults in the Minneapolis-St Paul, MN Metropolitan Area, 1980–1982 Through 2007–2009

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Background—Intake of dietary fatty acids has been linked to cardiovascular disease risk. However, data available to evaluate trends in fatty acid intake in the US population are limited, particularly with regard to *trans* fatty acids, docosahexaenoic acid (DHA), and eicosapentaenoic acid (EPA).

Methods and Results—The present analysis examined trends in fatty acid intake from 1980–1982 through 2007–2009 and compared levels of intake to those recommended in the 2010 Dietary Guidelines for Americans and by the American Heart Association. Twenty-four-hour dietary recalls were collected from 12 526 participants enrolled in the Minnesota Heart Survey, a series of 6 independent cross-sectional surveys designed to monitor cardiovascular risk factors in noninstitutionalized adults residing in the Minneapolis-St Paul, MN metropolitan area. Mean intake estimates were generated for each survey, and a generalized linear mixed model was used to test the null hypothesis of no difference in the age-adjusted, sex-specific means across survey years. Downward trends were observed for total, saturated, and *trans* fat as a percent of total energy in both men and women. However, mean intakes were still above recommended levels for both *trans* and saturated fatty acids. Mean intakes of DHA and EPA were also below recommended levels.

Conclusions—Despite promising trends, mean intakes of *trans* and saturated fatty acids do not meet current recommendations. Additional public health strategies are needed to promote recommended intakes of dietary fats. **(*J Am Heart Assoc*. 2014;3: e001023 doi: 10.1161/JAHA.114.001023)**

Key Words: dietary intake trends • epidemiology • Minnesota Heart Survey • saturated fatty acids • *trans* fatty acids

Rates of cardiovascular disease (CVD) mortality have decreased in recent years due to a combination of prevention and treatment efforts. Following lifestyle recommendations and meeting standard metrics of cardiovascular health can improve CVD risk factors and decreases CVD-related mortality risk.[1–5] Diet is an important modifiable risk factor, and the amount and type of dietary fat consumed has become one focus for dietary interventions.[3,5–8]

Recommendations for fatty acid intake have been issued to the public for the purposes of reducing CVD risk. The United States Department of Agriculture (USDA) 2010 Dietary Guidelines for Americans recommend daily total fat intake of 20% to 35% of energy intake, with saturated fatty acid (SFA) intake of <10% of energy and *trans* fatty acid intake as low as possible.[9] Similarly, the American Heart Association (AHA) recommends that intake of SFA be restricted to 5% to 6% of total energy intake and *trans* fatty acid intake to <1%.[10,11] In addition, the USDA and American Heart Association recommend increasing omega-3 intake, with a goal of consuming ≈0.25 g of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) per day.[9,10]

Is the American diet becoming more consistent with these recommendations? Data available to evaluate trends in fatty acid intake in the US population over the last several decades are limited, particularly with regard to examining changes in the *trans* fatty acid, DHA, and EPA content of the diet.[12,13] To contribute to the limited number of studies on this topic, the present analysis examines changes in intake of total fat and fatty acids from 1980–1982 through 2007–2009 using data on adults from the Minnesota Heart Survey.

Methods

Study Design

The design of the Minnesota Heart Survey has been previously described in detail.[14] Briefly, surveys were conducted in

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1980–1982, 1985–1987, 1990–1992, 1995–1997, 2000–2002, and 2007–2009, and included independent cross-sectional samples of noninstitutionalized adults in the 7-county metropolitan area of Minneapolis-St. Paul (Twin Cities), MN. Written, informed consent was obtained from all participants. For each survey, consent and data collection procedures were approved by the University of Minnesota Research Subjects' Protection Program's Institutional Review Board.

Survey Sample Selection

A detailed description of sample selection in the Minnesota Heart Survey has been published previously.[14,15] Briefly, for each survey, a 2-stage cluster design was utilized. In the first stage, 40 clusters (1980–1992), 44 clusters (1995–2002), or 47 clusters (2007–2009) were randomly selected from 704 census-based neighborhood clusters in the Twin Cities area. In the second stage, 5% to 10% of households within each cluster were randomly selected to produce a sample size of ≈5000 individuals. All adults meeting eligibility criteria were invited to participate in years 1980–1982, 1995–1997, 2000–2002, and 2007–2009. During the 1981–1982, 1985–1987, and 1990–1992 surveys, only 1 adult per household was invited to participate. Eligibility of participants was based on an age of 25 to 74 in surveys between 1980 and 1987, and an age of 25 to 84 in subsequent surveys.

Data Collection

Data were collected via a combination of home interviews and local clinic visits. The 15- to 45-minute home interview was performed by trained staff members to obtain sociodemographic characteristics, medical history, smoking habits, and information regarding health knowledge, attitudes, and beliefs. During the clinic visit, height and weight were measured using standard procedures. Body mass index was calculated as weight (kg) divided by height (m^2). Data regarding dietary intake and physical activity were also collected during the clinic visit. The response rate for both the home interview and clinic visit ranged from 60% to 69% across the survey periods among eligible individuals, with completers being slightly more likely to be married, better educated, employed, and nonsmokers.

Dietary Intake Data

One 24-hour dietary recall was administered in a systematic 50% sample of participants who completed the clinic visit in all surveys, except in 2000–2002 when all participants were asked to complete a 24-hour dietary recall. To achieve a 50% sample for dietary recalls, every other participant who attended a clinic visit was asked to complete a dietary recall. Generally, there were no demographic differences between those who completed the recalls and those who did not in each survey period with the exception of age. For some survey periods, those who completed a recall were slightly older than those who did not.

Collection of dietary data remained similar across the 6 survey periods. The 24-hour dietary recalls were collected by interviewers who were trained and certified by the University of Minnesota Nutrition Coordinating Center (NCC) (Minneapolis, MN). Data were gathered from participants using a multiple-pass approach,[12] with brand-specific information collected for food product categories where nutrient content differs markedly by brand. Three-dimensional food models along with visual aids (eg, household measuring cups and spoons, rulers) were available to assist participants in estimating the amount of food consumed. Beginning in 1995–1997 and all subsequent surveys, a computerized data-entry method (Nutrition Data System for Research) was utilized,[16] as compared to a paper-and-pencil manual collection method in prior survey years. To determine the comparability of the manual and computer-based collection methods, 107 participants completed dietary recalls using both methods during their clinic visit for the 1995–1997 survey. The differences in total energy (3.2 kcal), total fat (1.8 g), and percent energy from fat (1.1%) were not significantly different between the 2 methods ($P>0.05$).[17]

Fatty Acid Intake Estimates

Nutrient intake estimates were calculated using the University of Minnesota NCC Food and Nutrient Database.[18] This database is expanded and updated on an ongoing basis, with a new version released annually. The expansion and update work has 2 foci: (1) to keep the foods in the database comprehensive and up-to-date with the marketplace, and (2) to update and expand nutrients and other food components in the database. In 1998 and 2002, *trans* and omega-3 fatty acids were added, respectively, to the database. *Trans* fatty acids added include 16:1 *trans* (*trans*-hexadecenoic acid), 18:1 *trans* (*trans*-octadecenoic acid), and 18:2 *trans* (*trans*-octadecadienoic acid), which encompassed *cis-trans*, *trans-cis*, and *trans-trans* forms, and combined, comprise total *trans* fatty acids.

To obtain DHA, EPA, and *trans* fatty acid intake estimates for dietary recalls collected in the survey years before their addition to the database, a procedure within Nutrition Data System for Research that allows for automatically recalculating nutrient intake estimates using the most current version of the NCC Food and Nutrient Database available was utilized. This recalculation process is possible due to the time-related design of the NCC Food and Nutrient Database, with reformulated and discontinued foods kept in the database and assigned values for new nutrients added over time.

Fatty acid values for foods in the database are compiled from various sources. The USDA National Nutrient Database for

Standard Reference is the preferred source. Because the Standard Reference does not provide fatty acid values for many foods in the NCC Food and Nutrient Database, other sources of data are utilized including scientific literature and manufacturers' information (for brand name products in the database). As a result of use of a variety of data sources and application of standard imputation procedures,[18] there are no missing values for foods containing the fatty acids examined in this article.

An updated version of the NCC Food and Nutrient Database is released annually. USDA Standard Reference annual updates are incorporated into the database annually. Brand-specific updates to the database are done on a rotating basis, with different food categories updated each year. Thus, new products such as omega-3-enhanced eggs and product reformulations such as lower *trans* fat margarines are incorporated in the database. However, there is generally a lag of 1 to several years between the introduction/reformulation of a product in the marketplace and its addition to or update in the database.

Statistical Analysis

Data were analyzed using SAS version 9.3 (SAS Institute, Cary, NC). Only participants aged 25 to 74 with completed dietary recalls were included in the analysis (n=12 526).

A generalized linear mixed model (PROC MIXED) was used to estimate age-adjusted mean intakes of dietary fatty acids during each survey period and to test the null hypothesis of no difference in means between 1980–1982 and 2007–2009. Linear trend tests were also conducted to characterize change in intake over the survey periods. Neighborhood cluster was included as a random-effect term in these models to correct for design effects, which inflated the variance of sample means compared to what they would have been if considered independent (without the neighborhood cluster). Because of the well-established differences between males and females in nutrient requirements and energy intake, all analyses examining trends in fatty acid intake were conducted stratified by sex. Fatty acids were generally examined as a percent of total energy because most recommendations are expressed in this unit. The individual omega-3 fatty acids EPA and DHA are reported in g/day because recommendations for these fatty acids are in this unit of measure.

Results

Demographic information is presented in Table 1. Over the 6 survey periods, a total of 5869 men and 6657 women completed dietary recalls. With successive surveys, the

Table 1. Number and Percent of Participants by Sex, Age Group, Education Level, Ethnicity, and Body Mass Index: Minnesota Heart Survey 1980–1982 Through 2007–2009

	1980–1982		1985–1987		1990–1992		1995–1997		2000–2002		2007–2009	
	n	%	n	%	n	%	n	%	n	%	n	%
	1659	13.2	2273	18.2	2488	18.9	1842	14.7	2762	22.1	1502	12.0
Sex												
Male	798	48.1	1100	48.4	1141	45.9	860	46.7	1274	46.1	696	46.3
Female	861	51.9	1173	51.6	1347	54.1	982	53.3	1488	53.9	806	53.7
Age group (y)												
25 to 39	749	45.2	995	43.8	1103	44.3	650	35.3	926	33.5	384	25.6
40 to 54	503	30.3	722	31.8	822	33.0	701	38.1	1144	41.4	592	39.4
55 to 74	407	24.5	556	24.5	563	22.6	491	26.7	692	25.1	526	35.0
Education level												
Vocational or college	946	57.0	1442	63.4	1713	68.9	1329	72.2	2080	75.3	1243	82.8
High school or less	713	43.0	831	36.6	775	31.2	513	27.9	682	24.7	259	17.2
Ethnicity												
White	1592	96.0	2181	96.0	2366	95.1	1728	93.8	2483	89.9	1357	90.4
Non-white	67	4.0	92	4.1	122	4.9	114	6.2	279	10.1	145	9.7
Body mass index, kg/m^2												
<25	753	45.4	877	38.6	958	38.5	569	30.9	888	32.2	448	29.8
25.0 to 29.9	628	37.9	914	40.2	953	38.3	714	38.8	979	35.5	554	36.9
≥30	278	16.8	482	21.2	577	23.2	559	30.4	895	32.4	500	33.3

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Table 2. Sex-Specific Age-Adjusted Mean Intakes of Energy, Fat, and Fatty Acids Among Men Aged 25 to 74 Years in the Minneapolis-St. Paul Metropolitan Area: Minnesota Heart Survey 1980–1982 Through 2007–2009

	1980–1982		1985–1987		1990–1992		1995–1997		2000–2002		2007–2009		% Change*	*P* for Change†	*P* for Trend‡
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
Energy, kcal/d	2452	34.9	2481	29.9	2471	29.5	2493	33.8	2455	28.1	2449	37.6	−0.2	0.94	0.87
Total fat, % kcal	38.7	0.35	37.5	0.30	34.9	0.30	30.8	0.34	32.5	0.29	33.3	0.37	−14.0	<0.001	<0.001
SFA, % kcal	13.7	0.16	13.2	0.14	12.0	0.14	10.8	0.15	11.3	0.13	11.4	0.17	−16.8	<0.001	<0.001
MUFA, % kcal	14.9	0.16	14.2	0.14	13.0	0.14	11.6	0.15	12.3	0.13	12.4	0.17	−17.1	<0.001	<0.001
PUFA (% kcal)	6.6	0.11	7.0	0.10	7.1	0.09	5.8	0.11	6.2	0.09	6.9	0.12	4.1	0.11	<0.001
Total *trans* fat, % kcal	2.9	0.06	2.7	0.06	2.4	0.06	2.3	0.06	2.2	0.05	1.9	0.07	−32.3	<0.001	<0.001
20:5 PUFA, (EPA), g/d	0.06	0.006	0.05	0.005	0.04	0.005	0.04	0.006	0.05	0.005	0.04	0.006	−33.3	0.03	0.05
22:6 PUFA (DHA), g/d	0.10	0.010	0.08	0.008	0.07	0.008	0.07	0.010	0.10	0.008	0.09	0.011	−10.0	0.78	0.72
PUFA:SFA ratio	0.54	0.02	0.60	0.01	0.68	0.01	0.64	0.02	0.64	0.01	0.69	0.02	27.8	<0.001	<0.001

DHA indicates docosahexaenoic acid; EPA, eicosapentaenoic acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; SFA, saturated fatty acid.
*Percent change in intake between 1980–1982 and 2007–2009.
†*P* for change results from generalized linear mixed model analysis least square means tests comparing 1980–1982 and 2007–2009 intake estimates.
‡*P* for trend results from generalized linear mixed model analysis test for linear trends across the survey periods.

proportion of participants with college or vocational education increased, as did the proportions that were nonwhite and obese (body mass index ≥30).

Age-adjusted mean intakes of energy, total fat, and fatty acids among men are presented in Table 2. Percent of calories from total fat decreased from 38.7% in 1980–1982 to 33.3% in 2007–2009, a 14.0% decrease ($P<0.001$). SFA, monounsaturated fatty acid, and total *trans* fatty acid intakes also decreased (P for change <0.001 for all). *Trans* fatty acid intake decreased from 2.9% of energy to 1.9% in men, a significant reduction of 32.3%. Intake of individual *trans* fatty acids followed a similar pattern, with intake of 16:1, 18:1, and 18:2 *trans* fatty acids decreasing significantly over time (data not shown). While total polyunsaturated fatty acid (PUFA) intake exhibited a significant trend across surveys, only a small nonsignificant change in intake between 1980–1982 and 2007–2009 (4.1%) was observed. Due to reductions in SFA intake, the PUFA:SFA ratio increased between 1980–1982 and 2007–2009. With respect to select omega-3 fatty acids (EPA and DHA), while a significant change between 1980–1982 and 2007–2009 in intake of EPA in men was observed, the change was small in absolute terms (0.06 to 0.04 g/day, respectively).

Similar trends were observed in women (Table 3). Total fat, SFA, monounsaturated fatty acid, and *trans* fatty acid intake as a percent of total energy decreased significantly over the study period in women. Total fat intake as a percent of energy decreased from 38.4% to 32.9% between 1980–1982 and 2007–2009 (P for change <0.0001). In addition, a 35.9% decrease in *trans* fatty acid intake was observed, such that intake was ≈1.7% of energy during the 2007–2009 study period. Intake of individual *trans* fatty acids followed a similar pattern, with intake of 16:1, 18:1, and 18:2 *trans* fatty acid as a percent of energy decreasing over time (data not shown). There was a significant trend toward an increased PUFA:SFA ratio for women. No significant trends in intake of specific omega-3 fatty acids were observed for women. Intakes of EPA and DHA remained very low, with women in 2007–2009 consuming 0.04 and 0.08 g/day of these fatty acids, respectively.

Discussion

Overall, the results of the present study demonstrate encouraging trends, but offer evidence that current dietary recommendations for fatty acid intake are not being met in this population. In both men and women, mean intake of total fat as a percent of energy was within recommended intake levels, as of the 2007–2009 survey. However, mean intakes of *trans* and SFA are higher than recommended levels, and mean intakes of DHA and EPA are lower than recommended levels.

Trans fatty acid intake, as a percent of energy, decreased by >30% in men and women. This represents a greater decline than was observed in total fat, SFAs, and monounsaturated fatty acids. Similar results have been reported previously, with downward trends in intake of *trans* fatty acids and plasma *trans* fatty acid concentrations observed over time in US population groups.[12,13,19] This is, however, the longest

Table 3. Sex-Specific Age-Adjusted Mean Intake of Energy, Fat, and Fatty Acids Among Women Aged 25 to 74 Years in the Minneapolis-St. Paul Metropolitan Area: Minnesota Heart Survey 1980–1982 Through 2007–2009

	1980–1982		1985–1987		1990–1992		1995–1997		2000–2002		2007–2009		% Change*	*P* for Change†	*P* for Trend‡
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
Energy, kcal/d	1645	25.9	1644	23.0	1652	22.2	1851	25.2	1788	21.6	1808	27.3	9.9	<0.001	<0.001
Total fat, % kcal	38.4	0.35	36.1	0.31	33.9	0.30	30.6	0.34	32.1	0.29	32.9	0.37	−14.3	<0.001	<0.001
SFA, % kcal	13.5	0.17	12.7	0.15	11.9	0.14	10.5	0.16	11.2	0.14	11.4	0.17	−15.6	<0.001	<0.001
MUFA, % kcal	14.5	0.16	13.2	0.14	12.4	0.13	11.4	0.15	11.9	0.13	12.0	0.16	−17.2	<0.001	<0.001
PUFA, % kcal	7.2	0.12	7.2	0.10	6.9	0.09	6.2	0.11	6.3	0.09	6.9	0.12	−3.8	0.11	<0.001
Total *trans* fat, % kcal	2.7	0.05	2.4	0.05	2.3	0.04	2.2	0.05	2.2	0.04	1.7	0.06	−35.9	<0.001	<0.001
20:5 PUFA (EPA), g/d	0.03	0.004	0.03	0.003	0.02	0.003	0.02	0.004	0.03	0.003	0.04	0.004	33.3	0.56	0.44
22:6 PUFA (DHA), g/d	0.06	0.006	0.06	0.005	0.04	0.005	0.05	0.006	0.06	0.005	0.08	0.006	33.3	0.02	0.98
PUFA:SFA ratio	0.6	0.02	0.6	0.02	0.7	0.01	0.7	0.02	0.6	0.01	0.7	0.02	20.0	<0.001	0.003

DHA indicates docosahexaenoic acid; EPA, eicosapentaenoic acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; SFA, saturated fatty acid.
*Percent change in intake between 1980–1982 and 2007–2009.
†*P* for change results from generalized linear mixed model analysis least square means tests comparing 1980–1982 and 2007–2009 intake estimates.
‡*P* for trend results from generalized linear mixed model analysis test for linear trends across the survey periods.

population-based survey reporting trends in *trans* fatty acid intake, spanning nearly 30 years. Levels of *trans* fatty acid consumption are consistent with levels reported in the 1999–2002 National Health and Nutrition Examination Survey cohort and in CSFII,[20,21] suggesting that the present data may be somewhat generalizable to the larger US population.

Trans fatty acid consumption in the most recent survey period (2007–2009) averaged close to 2% of total energy, which is above the <1% of total energy recommended by the American Heart Association.[10] In an effort to reduce *trans* fatty acid intake, in 2006 the FDA mandated that manufacturers report *trans* fatty acid content as part of the nutrition facts panel of packaged food products.[22] While this action appears to have spurred a decrease in the *trans* fatty acid content of many food products through the elimination or reduction of partially hydrogenated vegetable oils,[22] a number of foods have exhibited only a small decline in *trans* fatty acid content.[23,24] In November 2013, the FDA began additional steps to rid the United States food market of *trans* fatty acids, by tentatively declaring partially hydrogenated vegetable oils as not generally recognized as safe for use in food products.[25] If finalized, this action by the FDA would prevent the use of partially hydrogenated vegetable oils by food manufacturers [25] and could lead to a further decline in *trans* fatty acid intake by the US population. Future research is necessary to determine the effects of this FDA action, if it is finalized.

The results of this study also demonstrate low consumption levels of PUFAs, DHA and EPA. PUFA intakes remained steady over time, making up about 6% to 7% of caloric intake. Similar levels of intake have been observed previously.[26] Intakes of EPA and DHA were on average 0.04 and 0.08 g/day, respectively, in men and women in the most recent survey period. These levels of intake are similar to previous studies.[27,28] Current recommendations from the USDA are to consume 0.25 g/day of a combination of EPA and DHA to reduce rates of cardiac death.[9] To meet this recommendation, twice the current level of consumption is needed.

Given the stability in EPA and DHA over the last 30 years, current strategies to increase consumption of these omega-3 fatty acids may not be effective. However, because recommendations regarding omega-3 intake were first instituted in 2006, more time may be needed to observe any effect of the recommendation on population behavior. While the main source of omega-3 fatty acids is fish and seafood, consumption of these foods is low in the United States, as compared to consumption of other meats, accounting for only about 10% of total meat intake in National Health and Nutrition Examination Survey 2003–2004 subjects.[29] As a result, numerous food manufacturers have begun to offer omega-3-fortified foods in an effort to increase consumption.[26] Additional research is needed to determine the effect that such fortification may have on population-level patterns of intake.

The results of the present study represent an important analysis of trends in fatty acid intake within a US population group. To date, this is the longest cross-sectional survey study allowing for the examination of fatty acid intake patterns over nearly 30 years. The methodology for collecting 24-hour dietary recalls (multiple-pass approach; in-person recall collection; use Nutrition Data System for Research software and database, etc.) remained remarkably consistent across the study period. As a result, trends in intake reported in this study are unlikely to be artifacts of change in study methodology. This is an important point, as a caveat of National Health and Nutrition Examination Survey is that trends in food and nutrient intake observed may be artifacts of notable changes in dietary intake assessment methodology between some survey periods.[30]

There are methodological issues that must be considered when interpreting findings. First, dietary intake was assessed via 24-hour dietary recalls. Underreporting of food intake is a pervasive problem with this method [31] and may have resulted in underestimation of intake of the fatty acids. In an attempt to account for this and to be consistent with the way recommendations have been issued, fatty acid intake estimates were examined as a percent of total energy intake. However, foods containing a high proportion of fat may be more likely to be underreported than foods that do not,[32] and as a result total fat and fatty acid intake as a percent of calories may also be underestimated. It is important to note that while this may result in underestimation of total fat and individual fatty acids, trends in fat consumption should be unaffected by this reporting bias, assuming the degree of underestimation of fat intake is similar over time.

It has been speculated that the magnitude of underreporting of intake may be increasing over time. Indeed, in our data we see evidence this may be the case because energy intake did not increase in accord with increasing rates of obesity over time. Rather, energy intake remained the same over time for men and increased in women between just 2 survey periods, a pattern that is inconsistent with the stepwise increase in obesity rates observed over time in this survey. If the magnitude of underreporting of energy intake increased over the survey period, trends in intake of fats reported in grams per day may be spurious. However, trends reported as a percent of total energy should not be affected, assuming underreporting is a worsening problem for all types of food prone to underreporting.

Another methodological consideration is that only one recall was collected from each participant in each survey. As a result, the proportion of survey participants with fatty acid intakes above or below the recommended levels cannot be determined. In addition, dietary supplement use was not assessed in a consistent manner across survey periods. As a result, trends in omega-3 supplement use, and the potential contribution of supplement use to overall omega-3 consumption level, cannot be examined.

Last, the participants were predominantly white men and women living in the Minneapolis-St. Paul area. As such, the results from the present study should be generalized only to similar populations. However, similarities between the present study and levels of intake reported from national data suggest that our results may generalize well to the US population.

In conclusion, results indicate that mean intakes of *trans* and SFA as a percent of total energy are higher than recommended levels, despite downward trends in intake. In addition, mean intakes of DHA and EPA are lower than recommended levels. Future research is needed to determine public health strategies to further reduce *trans* and SFA intake and to increase DHA and EPA intake in this population. This research could have implications for future dietary recommendations and public health strategies aimed at improving the American diet for cardiovascular disease prevention.

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Disclosures

None.

References

1. Yang Q, Cogswell ME, Flanders WD, Hong Y, Loustalot F, Gillespie C, Merritt R, Hu FB. Trends in cardiovascular health metrics and associations with all-cause and CVD mortality among US adults. *J Am Med Assoc*. 2012; 307:1273–1283.
2. Tunstall-Pedoe H, Kuulasmaa K, Mahonen M, Tolonen H, Ruokokoski E, Amouyel P. Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA project populations. Monitoring trends and determinants in cardiovascular disease. *Lancet*. 1999;353:1547–1557.
3. O'Flaherty M, Buchan I, Capewell S. Contributions of treatment and lifestyle to declining CVD mortality: why have CVD mortality rates declined so much since the 1960s? *Heart*. 2013;99:159–162.
4. National Heart Lung and Blood Institute. *Morbidity and Mortality 2012: Chartbook on Cardiovascular, Lung, and Blood Diseases*. Bethesda: National Institutes of Health; 2012.
5. Alpert JS. Coronary heart disease: where have we been and where are we going? *Lancet*. 1999;353:1540–1541.
6. Goldman L, Phillips KA, Coxson P, Goldman PA, Williams L, Hunink MG, Weinstein MC. The effect of risk factor reductions between 1981 and 1990 on coronary heart disease incidence, prevalence, mortality and cost. *J Am Coll Cardiol*. 2001;38:1012–1017.
7. Lloyd-Jones DM, Hong Y, Labarthe D, Mozaffarian D, Appel LJ, Van Horn L, Greenlund K, Daniels S, Nichol G, Tomaselli GF, Arnett DK, Fonarow GC, Ho PM, Lauer MS, Masoudi FA, Robertson RM, Roger V, Schwamm LH, Sorlie P, Yancy CW, Rosamond WD; American Heart Association Strategic Planning Task Force and Statistics Committee. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic Impact Goal through 2020 and beyond. *Circulation*. 2010;121:586–613.
8. Vannice G, Rasmussen H. Position of the Academy of Nutrition and Dietetics: dietary fatty acids for healthy adults. *J Acad Nutr Diet*. 2014; 114:136–153.

9. U.S. Department of Agriculture, U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th ed. Washington, DC: U.S. Government Printing Office; 2010.
10. American Heart Association Nutrition Committee, Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris WS, Howard B, Karanja N, Lefevre M, Rudel L, Sacks F, Van Horn L, Winston M, Wylie-Rosett J. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation*. 2006;114:82–96.
11. Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Houston Miller N, Hubbard VS, Lee IM, Lichtenstein AH, Loria CM, Millen BE, Nonas CA, Sacks FM, Smith SC Jr, Svetkey LP, Wadden TA, Yanovski SZ, Kendall KA, Morgan LC, Trisolini MG, Velasco G, Wnek J, Anderson JL, Halperin JL, Albert NM, Bozkurt B, Brindis RG, Curtis LH, DeMets D, Hochman JS, Kovacs RJ, Ohman EM, Pressler SJ, Sellke FW, Shen WK, Smith SC Jr, Tomaselli GF. AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;29:S76–S99.
12. Harnack LJ, Lee S, Schakel SF, Duval S, Luepker RV, Arnett DK. Trends in the *trans*-fatty acid composition of the diet in a metropolitan area: the Minnesota Heart Survey. *J Am Diet Assoc*. 2003;103:1160–1166.
13. Hu FB, Stampfer MJ, Manson JE, Grodstein F, Colditz GA, Speizer FE, Willett WC. Trends in the incidence of coronary heart disease and changes in diet and lifestyle in women. *N Engl J Med*. 2000;343:530–537.
14. Luepker RV, Jacobs DR, Gillum RF, Folsom AR, Prineas RJ, Blackburn H. Population risk of cardiovascular disease: the Minnesota Heart Survey. *J Chronic Dis*. 1985;38:671–682.
15. Luepker RV, Jacobs DR Jr, Folsom AR, Gillum RF, Frantz ID Jr, Gomez O, Blackburn H. Cardiovascular risk factor change—1973–74 to 1980–82: the Minnesota Heart Survey. *J Clin Epidemiol*. 1988;41:825–833.
16. Feskanich D, Sielaff BH, Chong K, Buzzard IM. Computerized collection and analysis of dietary intake information. *Comput Methods Programs Biomed*. 1989;30:47–57.
17. Lee S, Harnack L, Jacobs DR, Steffen LM, Luepker RV, Arnett DK. Trends in diet quality for coronary heart disease prevention between 1980–1982 and 2000–2002: the Minnesota Heart Survey. *J Am Diet Assoc*. 2007;107:213–222.
18. Schakel SF, Sievert YA, Buzzard IM. Sources of data for developing and maintaining a nutrient database. *J Am Diet Assoc*. 1988;88:1268–1271.
19. Schwenke DC, Foreyt JP, Miller ER, Reeves RS, Vitolins MZ; the Oxidative Stress Subgroup of the Look AHEAD Research Group. Plasma concentrations of *trans* fatty acids in persons with type 2 diabetes between September 2002 and April 2004. *Am J Clin Nutr*. 2013;97:862–871.
20. Kris-Etherton PM, Lefevre M, Mensink RP, Peterson B, Fleming J, Flickinger BD. *Trans* fatty acid intakes and food sources in the U.S. population: NHANES 1999–2002. *Lipids*. 2012;47:931–940.
21. Allison DB, Egan K, Barraj LM, Caughman C, Infante M, Heimbach JT. Estimated intakes of *trans* fatty and other fatty acids in the U.S. population. *J Am Diet Assoc*. 1999;99:166–174.
22. Borra S, Kris-Etherton PM, Dausch JG, Yin-Piazza S. An update of *trans*-fat reduction in the American diet. *J Am Diet Assoc*. 2007;107:2048–2050.
23. Mozaffarian D, Jacobson MF, Greenstein JS. Food reformulations to reduce trans fatty acids. *N Engl J Med*. 2010;362:2037–2039.
24. Ottite FO, Jacobson MF, Dahmubed A, Mozaffarian D. Trends in trans fatty acids reformulations of US supermarket and brand-name foods from 2007 through 2011. *Prev Chronic Dis*. 2013;10:120198.
25. Food and Drug Administration. Tenative determination regarding partially hydrogenated oils; Request for comments and for scientific data and information. Available at: https://federalregister.gov/a/2013-26854. Federal Register; 2013:67169–67175.
26. Kris-Etherton PM, Taylor DS, Yu-Poth S, Huth P, Moriarty K, Fishell V, Hargrove RL, Zhao G, Etherton TD. Polyunsaturated fatty acids in the food chain in the United States. *Am J Clin Nutr*. 2000;71:179S–188S.
27. Sun Q, Ma J, Campos H, Hankinson SE, Hu FB. Comparison between plasma and erythrocyte fatty acid content as biomarkers of fatty acid intake in US women. *Am J Clin Nutr*. 2007;86:74–81.
28. Ervin RB, Wright JD, Wang C-Y, Kennedy-Stephenson J. Dietary intake of fats and fatty acids for the United States population: 1999–2000. *Adv Data*. 2004;348:1–6.
29. Daniel CR, Cross AJ, Koebnick C, Sinha R. Trends in meat consumption in the United States. *Public Health Nutr*. 2011;14:575–583.
30. Archer E, Hand GA, Blair SN. Validity of U.S. National Surveillance: National Health and Nutrition Examination Survey caloric energy intake data, 1971–2010. *PLoS One*. 2013;8:e78832.
31. Black AE, Prentice AM, Goldberg GR, Jebb SA, Bingham SA, Livingstone MB, Coward WA. Measurements of total energy expenditure provide insights into the validity of dietary measurements of energy intake. *J Am Diet Assoc*. 1993;93:572–579.
32. Tooze JA, Subar AF, Thompson FE, Troiano R, Schatzkin A, Kipmis V. Psychosocial predictors of energy underreporting in a large doubly labeled water study. *Am J Clin Nutr*. 2004;79:795–804.