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Levels of Plasma *trans*-Fatty Acids in Non-Hispanic White Adults in the United States in 2000 and 2009

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To the Editor

Levels of *trans*-fatty acids (TFAs) in blood come from natural sources, such as milk, and industrial sources, such as partially hydrogenated vegetable oils. Dietary intake of TFAs increases low-density lipoprotein cholesterol (LDL-C) and has other adverse metabolic effects.[1] Changing to a diet low in TFAs may lower the LDL-C level and decrease the risk for cardiovascular disease. To assist consumers, the Food and Drug Administration amended its regulations in 2003 to require that TFA content be declared on the nutrition label of foods and dietary supplements.[2] Some community and state health departments have required restaurants to limit TFAs and reductions have been shown in supermarket and restaurant products.

The public health impact of these changes on TFA blood levels in the population is unknown. A preliminary study was conducted to determine plasma concentrations of TFAs in a subset of non-Hispanic white adults in the National Health and Nutrition Examination Survey (NHANES) in 2000 and 2009.

Methods

NHANES is a cross-sectional survey of the non-institutionalized civilian population of the United States performed annually with a complex multistage probability design, weighted to

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Study concept and design: Johnson, Pirkle.
Acquisition of data: Kuiper.
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Drafting of the manuscript: Vesper, Kuiper.
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be nationally representative.[3] Half of the white persons aged 20 years or older who had a morning fasting blood sample in 2000 and 2009 were randomly selected. The protocol was approved by the National Center for Health Statistics Ethics Review Board and written informed consent was obtained.

Four TFAs (elaidic acid [C18:1n-9t], vaccenic acid [C18: 1n-7t], linoelaidic acid [C18:2n-6t, 9t], and palmitelaidic acid [C16:1n-7t]) were measured in plasma stored at −70°C, following previously described procedures.[4,5] These are the 4 major TFAs and provide a reasonable representation of TFAs in blood.[6] Their presence in blood cannot be used to distinguish food intake from natural vs industrial sources. There are no established reference ranges for TFA levels.

Statistical analysis was performed using SAS version 9.2 (SAS Institute Inc) and SUDAAN version 10.0 (Research Triangle Institute) by calculating weighted geometric means of the TFAs and the sum of the 4 TFAs using log-transformed data and single-year replicate NHANES examination weights. In addition, differences in the geometric means of the TFAs and the sum of the 4 TFAs from 2000 to 2009 and their 95% confidence intervals were calculated. Mean levels of LDL-C for this subset of NHANES participants from both years were determined. Because NHANES visits a limited number of locations per year, annual samples are nationally representative but the variance estimates for single-year data are higher than for multi-year data, preventing further analysis by more detailed levels of stratification.

Results

There were 229 participants selected from 2000 and 292 from 2009 (TABLE 1). Levels of TFAs were detectable in all samples. The levels of vaccenic acid decreased from 43.7 μmol/L in 2000 to 19.4 μmol/L in 2009 (difference of 56%: 24.3 μmol/L [95% CI, 19.6-29.0 μmol/L]). Similar changes were seen in elaidic acid, palmitelaidic acid, and linoelaidic acid. The weighted geometric mean of the difference for the sum of all 4 TFAs was 54.1 μmol/L (95% CI, 43.4–64.7 μmol/L) or 58% lower in samples from 2009 compared with samples from 2000 (TABLE 2). Levels of LDL-C were lower in the samples from 2009 (119.2 mg/dL [3.09 mmol/L]) compared with the samples from 2000 (128.2 mg/dL [3.32 mmol/L]; Table 1).

Comment

This study is, to our knowledge, the first time information on TFAs in white adults in the US population has been examined. Plasma levels of TFAs were substantially lower in 2009 than in 2000. This may lead to a decrease in risk for cardiovascular disease in this subpopulation. Because this study was limited to only 2 years and only a few parameters, it does not allow for detailed assessments of the association with LDL-C level or other factors. These findings provide preliminary data on white adults only and cannot be generalized to other racial/ethnic and age groups. Further studies to address these limitations are ongoing.

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Table 1

Characteristics of Fasting Non-Hispanic Whites Aged 20 Years or Older[a]

	NHANES Year of Specimen Collection	
	2000 (n = 229)	**2009 (n = 292)**
Proportion of males, % (SE)	47.2 (2.7)	47.1 (2.7)
Weighted age, median (range), y[b]	45 (20–80)	46 (20–80)
Body mass index, median (interquartile range)[c]	26.4 (22.4–30.9)	27.5 (23.9–31.6)
Cholesterol, mean (SE), mg/dL		
Low-density lipoprotein[d]	128.2 (2.7)	119.2 (2.3)
High-density lipoprotein[e]	49.6 (1.7)	55.8 (2.1)
Triglycerides, geometric mean (SE), mg/dL[f]	131.1 (5.2)	109.3 (5.8)

Abbreviation: NHANES, National Health and Nutrition Examination Survey.

SI conversion factors: To convert high- and low-density lipoprotein cholesterol to mmol/L, multiply by 0.0259; triglycerides to mmol/L, multiply by 1.8.

[a] Race/ethnicity was defined by participant (self-reported). All estimates are weighted using single-year replicate NHANES examination weights.

[b] Age has been top-coded at 80 to protect confidentiality.

[c] Calculated as weight in kilograms divided by height in meters squared. Due to missing data, the sample size is 289 for 2009.

[d] Due to missing data, the sample size is 222 for 2000 and 280 for 2009.

[e] Due to missing data, the sample size is 228 for 2000 and 291 for 2009.

[f] Due to missing data, the sample size is 228 for 2000 and 290 for 2009.

Table 2

Levels of *trans*-Fatty Acids in Fasting Non-Hispanic Whites Aged 20 Years or Older[a]

	NHANES 2000		NHANES 2009		From NHANES 2000 to 2009	
	No.	Geometric Mean (95% CI), μmol/L	No.	Geometric Mean (95% CI), μmol/L	Difference in Geometric Mean (95% CI), μmol/L	Decrease, %
Vaccenic acid	229	43.7 (39.1–48.2)	291	19.4 (16.9–21.9)	24.3 (19.6–29.0)	56
Elaidic acid	229	38.2 (33.0–43.4)	292	14.0 (11.6–16.3)	24.2 (19.1–29.3)[b]	63
Palmitelaidic acid	229	7.9 (7.3–8.5)	291	4.0 (3.6–4.5)	3.9 (3.2–4.6)	49
Linoelaidic acid	227	2.6 (2.2–2.9)	290	1.3 (1.2–1.5)	1.3 (1.0–1.6)	49
Sum of *trans*-fatty acids	229	93.1 (82.5–103.6)	292	39.0 (33.7–44.3)	54.1 (43.4–64.7)	58

[a]Single-year replicate National Health and Nutrition Examination Survey (NHANES) weights were used because fasting subsample weights were not available for this analysis.

[b]Slight differences due to rounding.