

Current Research

Personal and Professional Correlates of US Medical Students' Vegetarianism

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ABSTRACT

Objective To determine prevalence and correlates of US medical students' self-identification as vegetarians.

Design Medical students were anonymously surveyed via questionnaire three times: at freshmen orientation, orientation to wards, and during senior year.

Subjects Medical students in the Class of 2003 (n=1,849) at 15 US medical schools (response rate 80%).

Outcome measures We examined self-reported vegetarianism, abstinence from meat items on a food frequency questionnaire, and associations between students' vegetarianism and their health-related outcomes.

Statistical analyses Bivariate associations were tested with χ^2 tests.

Results During medical school, 7.2% of students self-identified as vegetarians; this percentage declined over time. Those who were vegetarians for health reasons (66% of vegetarians) ate more fruits and vegetables than those who were vegetarians for nonhealth reasons ($P=0.02$). Vegetarians were more likely ($P<0.01$) than nonvegetarians to eat more fruits and vegetables ($P=0.002$); be women ($P=0.009$); be Hindu, Buddhist, or Seventh Day Adventist ($P\leq 0.0004$); be politically liberal ($P=0.007$); have a body mass index ≤ 25 ($P=0.008$); or, as freshmen, to perceive nutrition counseling as highly relevant to

their intended practices ($P=0.007$). Vegetarian students were no more likely to counsel patients about nutrition than were nonvegetarians.

Conclusions Prevalence of vegetarianism was higher among US medical students than among other US adults, although the prevalence declined during medical school. Medical students and physicians with healthful personal practices are more likely to encourage such behaviors in their patients, although the specific nutrition habit of vegetarianism among medical students was unassociated with their nutrition counseling practices.

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Plant-based and vegetarian diets* are potentially therapeutic (1-11), and are correlated with some physicians' likelihood to provide patient nutrition counseling (12). Vegetarian, vs omnivorous, diets have been associated in large survey and prospective cohort studies with lower body weights and lower rates of overweight body mass indexes (1-4), fewer diabetic complications (5) and less self-reported diabetes (6), and lower mortality from ischemic heart disease and certain cancers (1,7). In US clinical intervention trials, a low-fat vegetarian diet has been shown (even without the effects of exercise) to reduce diabetic complications (8), serum cholesterol (9), and symptoms of rheumatoid arthritis (10) and fibromyalgia (11). In addition to these findings, vegetarianism has been associated with eating less saturated fat, and more complex carbohydrates, fruits and vegetables, fiber, folate, and other phytochemicals (2,13).

Exploring the characteristics associated with vegetarianism in a health-educated population such as medical students will help determine if this dietary trend is associated with other healthful personal and clinical practices. More healthful dietary patterns are associated with increased nutrition counseling attitudes (14,15) and practices (12,15-18) of physicians (12,14,16-18) and medical students (15). Specifically, nutrition counseling is more frequent among those following a "prudent diet" (17), eating less fat (12,16), and eating more fruits and vegetables (15). The Women Physicians' Health Study (19) is a study of 4,501 women physicians' personal and clinical health practices. Women vegetarian physicians in this study report performing nutrition counseling for patients more frequently than do nonvegetarian women physicians (12). Some small studies demonstrate that training

*Whereas plant-based diets are limited in meat, fish, and fowl, vegetarian diets exclude all meat, fish, and fowl.

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interventions may improve both medical students' personal dietary behaviors (20) and disease-prevention counseling attitudes (20-22). Building on these preliminary associations, we implemented the Healthy Doc-Healthy Patient study, to describe medical students' attitudes and behaviors regarding personal and clinical prevention, and the relationship between their personal and clinical practices (23).

The preliminary objective of this article is to provide vegetarian prevalence data on US medical students throughout their education; this includes comparing various definitions of, and reasons for, vegetarianism. The primary objective of this article is to examine dietary and other personal health characteristics, as well as mentoring and clinical characteristics, for association with US medical students' vegetarianism.

METHODS

Study Design

All Class of 2003 medical students at 17 representative (24-27) US schools were eligible for participation in this study at each of three questionnaire administrations (given at freshman orientation in 1999, at ward orientation, and during senior year). We have more fully described our sampling and data collection methods elsewhere (28). We excluded one school from the Healthy Doc-Healthy Patient study for protocol nonadherence.

Loma Linda University Medical School was the only US medical school associated with a religious movement that promotes vegetarianism, and was therefore excluded from this analysis (to enhance the sample's representativeness). After excluding Loma Linda University, 1,849 students responded at one or more time points, 1,502 responded at more than one time point, and 857 students were tracked across all three survey time points. There was no written consent. However, our study received Institutional Review Board approval and conformed to Health Insurance Portability and Accountability Act guidelines at the study coordinating center.

Variables

Independent variables were primarily chosen a priori from variables significantly associated with women physicians' or other adults' vegetarianism in the literature (1,2,4,5,8). Vegetarian self-identification was cross-tabulated with the following Healthy Doc-Healthy Patient study medical student variables: time, demographic characteristics (eg, sex, ethnicity, marital status, children, religion, and political affiliation), dietary practices (eg, fruits and vegetables, dairy, and meat), nondietary health attributes and practices (eg, body mass index, physical exercise in an average week, perceived general health, alcohol use in past month, and tobacco use in past month), mentor/family influences (eg, "how much emphasis have your physicians placed on helping you stay healthy and preventing disease," and family encouragement of healthful eating), and clinical characteristics (eg, intended specialty, perceived relevance of nutrition counseling, and reported frequency of nutrition counseling).

Within each Healthy Doc-Healthy Patient study questionnaire, a brief food frequency questionnaire (FFQ)

queried consumption (from zero to six times per day, week, or month) of 40 food/beverage and three supplement items. Validation of this modified Block FFQ (29) is described more fully elsewhere (30). Although the vegetarian self-identification item was not validated, validation of other Healthy Doc-Healthy Patient questionnaire items has been previously described (31,32). Total servings per day of fruits and vegetables was a sum of french fries, other potatoes, fruit juice, fruit, vegetable juice, green salad, vegetable soup, and other vegetables (30). Fruits and vegetables were the only dietary variable in our analyses because we found that, in a calibration sub-study of our FFQ vs five 24-hour recalls, our FFQ's fruit and vegetable estimates correlated higher with recall estimates ($r=0.5$) than did other dietary variables ($r<0.4$) (30). At each time point, intended specialties were collapsed into primary care, nonprimary care, and undecided. Queries on perceived relevance of nutrition counseling were made on each Healthy Doc-Healthy Patient questionnaire, and the senior year questionnaire also queried frequency of talking to patients about nutrition.

Self-identified vegetarianism was assessed on each Healthy Doc-Healthy Patient questionnaire: "Do you consider yourself a vegetarian? (yes, no)." Vegetarianism was secondarily characterized by a reported zero intake of meat items on each FFQ administration, where "meat" refers to all nonfowl, nonfish flesh. To characterize vegetarians, we compared various meat item responses to the dichotomous self-identification item. After this initial comparison, only those who responded positively to the self-identification question on at least one Healthy Doc-Healthy Patient questionnaire were considered vegetarians because $\leq 1.3\%$ of individuals omitted this question vs $\leq 12.5\%$ who omitted meat items on the FFQ.

Analytical Methods

Analyses were conducted using SUDAAN (version 8.0.2, 2003, Research Triangle Park, Cary, NC), a program that accounts for nonindependent observations arising from the clustering of students into schools and the repeated responses from each student over time. The cross-tabulated associations of individual items with categorical predictors were tested using the χ^2 test. We tested for statistical significance of bivariate associations with a $P\leq 0.01$; we limited our discussion of marginal significance to those associations with a $P\leq 0.05$.

RESULTS

Our response rates were 87%, 77%, and 76% on three questionnaire administrations, and our overall response rate was 80.2%, including respondents from any of the three survey administrations and any of the 16 schools.

The number of students who considered themselves vegetarians (7.2%) was less than the number who reported consuming no meat (10.0%), but more than the number who reported consuming no meat, fish, or fowl (4.0%). This trend was also reported by each sex. Around 10% of women and 5% of men considered themselves vegetarians, but about half as many students (5.2% of women and 3.1% of men) reported consuming no flesh in their typical diets. All subsequent references to vegetar-

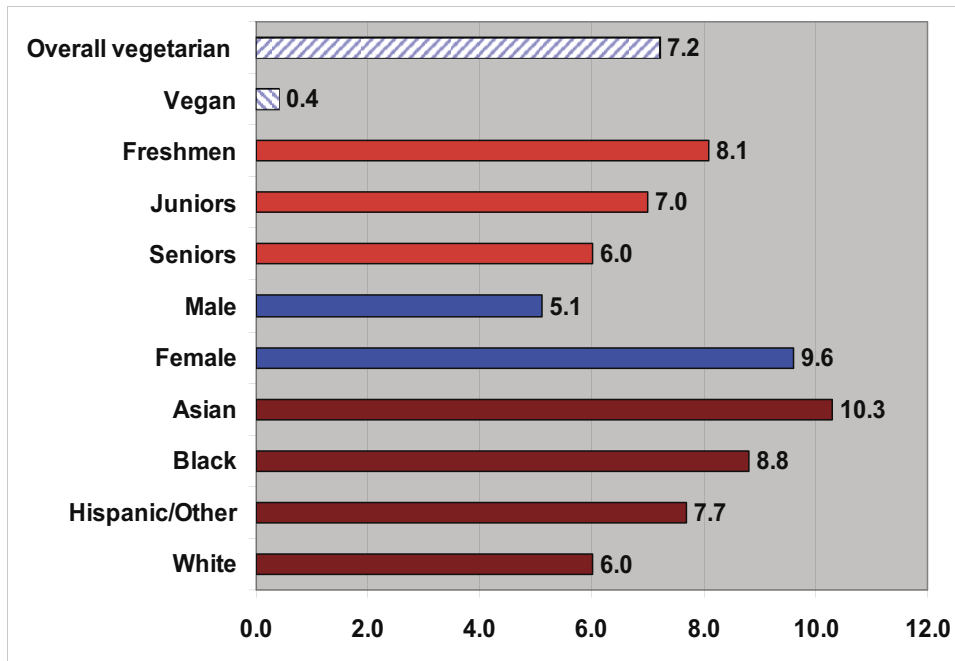


Figure. Prevalence of vegetarianism (determined by a positive response to the question, “Do you consider yourself a vegetarian? (yes, no),” among US medical students from 1999 to 2003, by time, sex, and ethnicity. Vegetarianism was defined in this and subsequent tables by a positive response to the vegetarian self-identification question.

Table 1. Selected dietary practices associated from 1999 to 2003 with vegetarianism of US medical students^a

	All vegetarians	Vegetarian for at least health reasons ^b	Vegetarian for nonhealth reasons ^c	Nonvegetarians	P value ^d
Median fruit and vegetable servings/d	3.4	3.5	3.3	2.7	0.002**
Median dairy servings/d	1.4	1.2	1.4	1.1	0.02*
Mean meat or fowl servings/d	0.09	0.05	0.2	1.3	0.0002***
Median meat or fowl servings/d	0.0	0.0	0.0	1.1	0.0001***
Eats meat or fowl ≥ 1 /week (%)	8.9	6.3	14.6	97.7	<0.0001***
Eats meat or fowl ≤ 1 /mo (%)	82.5	86.1	77.2	1.3	<0.0001***

^aIncludes data on non-Loma Linda University vegetarians.
^bThis column reports dietary practices of vegetarians who cite health (and potentially other reasons) as a reason for being vegetarian.
^cThis column reports dietary practices of vegetarians who failed to cite health as a reason for being vegetarian.
^dFor all vegetarians vs nonvegetarians based on χ^2 analysis.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

ians refer only to self-identified vegetarians. Self-identification was stable over time, with $\leq 3\%$ of those who considered themselves vegetarian at some time point changing their response on a subsequent questionnaire.

Entering students' prevalence of vegetarianism was 8.1%, decreasing during school to 6.0% ($P=0.02$; see the Figure). There were nearly twice as many female as male vegetarians ($P=0.009$), and a greater number of Asian than white vegetarians ($P=0.05$).

The 320 vegetarian students indicated ≥ 1 reason(s) for vegetarianism (data not shown). The most commonly cited reason for self-reported vegetarianism was health

(66%). Less common reasons were animal welfare (47%), environment (34%), tasting better (31%), religion (28%), weight control (14%), and “other” reasons (11%). In the Loma Linda University sample of 129 vegetarians, religion was more motivating (44% cited it as a reason vs 28% in our sample) and environment was less motivating (15% vs 34%).

Vegetarians consumed significantly ($P < 0.02$) more fruits and vegetables and dairy than did nonvegetarians (Table 1). As previously reported (15), all students' mean fruit and vegetable consumption was low and declined during school. Because some vegetarians have reported

Table 2. Selected personal and clinical characteristics^a of US medical students from 1999 to 2003, stratified by whether or not they were vegetarian

Characteristic	Vegetarians	Nonvegetarians	P value ^b
Personal	← % →		
Female	60	45	0.009**
Asian or African American vs white, Hispanic, or other (referent)	40	28	0.06
Single, divorced, or widowed vs married or unmarried couples ^c	78	76	0.6
Without children	96	94	0.03*
Atheist, agnostic, or no religion vs Jewish, Muslim, or other ^c	24	19	0.003** overall ^d
Seventh Day Adventist ^e , Buddhist, or Hindu vs Jewish, Muslim, or other ^c	29	6	
Protestant, Catholic, Mormon, other Christian vs Jewish, Muslim, or other ^c	30	60	
Fairly or very politically liberal vs moderate, fairly, or very conservative ^c	90	74	0.007**
All students with nonoverweight body mass index (<25) vs overweight or obese body mass index ^c			0.008**
Women with nonoverweight body mass index (<25) vs overweight or obese body mass index	95	89	0.02*
Men with nonoverweight body mass index (<25) vs overweight or obese body mass index ^c	73	63	0.1
Complying with centers for disease control and prevention exercise recommendations ^f	62	61	0.6
≥Very good perceived health vs good, fair, or poor health ^c	81	80	0.9
All students' bingeing or heavy drinking ^g vs light, infrequent, or not drinking ^c			0.04*
Women's bingeing or heavy drinking vs light, infrequent, or not drinking	28	34	0.2
Men's bingeing or heavy drinking vs light, infrequent, or not drinking	37	44	0.5
All students using tobacco ^h vs never used or having ceased use ^c			0.02*
Women using tobacco vs never used or having ceased use	11	14	0.8
Men using tobacco vs never used or having ceased using	15	28	0.02*
Mentor			
Physicians placing "some" or "a lot" of preventive emphasis vs not much or no emphasis ^c	63	63	0.9
Agreeing (or strongly agreeing) that family encouraged healthful eating vs neither agreeing nor disagreeing	71	65	0.06 overall ^d
Disagreeing (or strongly disagreeing) that family encouraged healthful eating vs neither agreeing nor disagreeing ^c	16	20	
Clinical			
Primary care intended specialties vs nonprimary care or undecided ^c	43	40	0.5
Perceiving nutrition counseling as highly relevant ⁱ vs somewhat or not at all relevant ^c			0.05*
Freshmen orientation	81	69	0.007**
Ward orientation	65	62	0.7
Senior year	41	43	0.7
Usually/always provide nutrition counseling ^j vs sometimes or never/rarely ^c	13	17	0.09

^aThese data compare the percentage of vegetarians with selected characteristics to nonvegetarians with those same characteristics.

^bBased on χ^2 analysis.

^cReferent group.

^dIndicates a difference between any levels of a variable with >2 levels.

^eOnly Seventh Day Adventists not attending the Adventist school, Loma Linda University, are included.

^fRecommendation: moderate-intensity activity for 30 min ≥5 times/wk or vigorous-intensity activity for 20 min ≥3 times/wk.

^gBinger/heavy drinker in previous month if: on ≥1 occasion consumed >4 drinks, on each occasion, averaged >4 drinks if man or >3 drinks if woman, or per day, averaged >2 drinks if man or >1 drink if woman.

^hTobacco use in previous month includes light/infrequent tobacco use: <20 days of <10 cigarettes/smoking day, <20 days of any noncigarette tobacco use, or combinations that did not exceed 19 total days; heavy/frequent use: smoked >10 cigarettes/smoking day or used any tobacco on ≥20 days.

ⁱDetermined by question, "How relevant do you think talking to patients about nutrition will be in your intended practice? (not at all, somewhat, highly)."

^jDetermined by question, "With a typical general medicine patient, how often do you actually talk to your patients about nutrition? (never/rarely, sometimes, usually/always)."

* $P < 0.05$.

** $P < 0.01$.

eating some meat (3), we examined whether or not vegetarians for (at least) health reasons ate differently than other vegetarians. Meat consumption among the health-

motivated vegetarians did not differ ($P=0.5$) from that of other vegetarians, but the health-motivated vegetarians consumed comparatively more fruits and vegetables

($P=0.02$). Although the difference was not statistically significant (due to small numbers), vegetarians for health reasons were less than half as likely (6.3% compared with 14.6%) to eat meat/fowl as frequently as those who were vegetarian for nonhealth reasons.

In bivariate analyses (Table 2), vegetarians were more likely ($P\leq 0.01$) to be a woman ($P=0.009$), Buddhist, Hindu, or Seventh Day Adventist vs all others ($P=0.0004$), politically liberal or very liberal ($P=0.007$), of a healthful weight or underweight ($P=0.008$), or to perceive nutrition counseling as highly relevant to her/his intended practice at freshmen orientation ($P=0.007$). Vegetarianism was marginally associated with not having children ($P=0.03$), being a healthful weight or underweight woman ($P=0.02$), being less likely to drink alcohol heavily or to binge drink ($P=0.04$), or being a non-tobacco-using male ($P=0.02$). Vegetarianism was not related to nutrition counseling. Overall, 17% of seniors ($n=207$) usually/always counseled their general medicine patients about nutrition (15), and this did not differ by vegetarian self-identification ($P=0.09$).

DISCUSSION

The prevalence of vegetarianism was higher among medical students than among other US adults. Our sample was 7.2% vegetarian and nationally, in 2000, the estimated prevalence of self-identified vegetarianism is 2.5% (33). In 2003, the percentage of 18- to 24-year-olds reporting never eating meat, fish, or fowl was also smaller (2.0%) than the analogous percentage of similarly aged medical students in our study (4.0%) (34).

The percentage of vegetarians declined during medical school; this parallels students' declines during medical school in other health-related habits: fruit and vegetable consumption (15), vitamin/mineral supplement use (35), and physical exercise (36). Vegetarianism prevalence among freshmen was not maintained despite increased medical education, new data from clinical interventions and reviews confirming the benefits of vegetarian diets, and other secular trends. The declines in personal healthful behaviors may reflect the disruption clinical rotations create, for example in students' typical or preferred eating patterns. Crapse and colleagues (37) reported that nearly 80% of a small number of medical students ($n=52$) surveyed in their second year reported increased caffeine consumption and decreased exercise since freshmen year. Furthermore, education or interests in nutrition or health do not necessarily translate into calling oneself vegetarian (as demonstrated by one third of these medical student vegetarians not considering health to be even one reason they were vegetarian).

Those who were vegetarians for health reasons ate more fruits and vegetables than did vegetarians for non-health reasons. Small sample sizes precluded us from knowing whether or not the health-motivated vegetarians also ate significantly less meat than vegetarians motivated by nonhealth reasons. Many diseases are linked with deficient consumption of fruits and vegetables (38,39) and excessive consumption of (nonfish) meat, especially red/processed meat (40-42); our findings suggest that the varying motives of vegetarians may influence their dietary choices and therefore their potential health outcomes.

Our finding that women medical students were much more likely to be vegetarian than men medical students was supported by a Harris survey of 1,031 adults (34); US women were more likely to report "never eating meat, fish, or fowl" (3.6%) than were US men (2.0%). The higher proportion of women among vegetarians may have contributed to the higher perceived relevance of nutrition counseling among vegetarian freshmen because women were consistently more likely to perceive nutrition counseling as highly relevant (15). Although vegetarian students were somewhat more likely to believe in the relevance of nutrition counseling, they were no more likely to usually/always provide nutrition counseling to patients. This may be because two thirds of the vegetarian students surveyed were motivated to be vegetarian by reasons other than their own health. This majority of students may not have found nutrition compelling either personally or clinically.

Vegetarianism was associated with healthful personal practices such as eating more fruits and vegetables and being less overweight. Vegetarian students, like other US vegetarians (2,3), tended to be less overweight than their nonvegetarian colleagues. Because obesity has been linked to a host of health conditions including arthritis (43), cancer (44), cardiovascular disease (45), diabetes (41,43), high cholesterol (43), and hypertension (43), the lower weight of vegetarian women students may be desirable in the current US epidemic (43,46) and global pandemic (47,48) of obesity.

A limitation of our study is that rather than being able to identify predictors of students' vegetarianism, we were limited to describing its correlates at three discrete times. In addition, although our sample of schools was nationally representative (24-28), it was not random; this reduces the generalizability of our results. Our data were self-reported and, therefore, potentially subject to an overreporting bias of vegetarianism or other behaviors and attitudes deemed socially desirable or more healthful.

The principal strength of this study is that we were able to track nearly 900 nationally representative medical students across three questionnaires throughout medical school. Although we used vegetarian self-identification at a particular time point for any given analysis, we determined that the percentage of our sample that changed this self-identification over time was very small ($\leq 3\%$). An additional strength is that our study compared the prevalence of vegetarianism via self-identification and self-reported food consumption. We were able to examine whether students' vegetarianism was significantly associated with outcomes of great importance to patient health: attitudes (17) and behaviors (49) regarding nutrition counseling of patients.

CONCLUSIONS

Plant-based diets are healthful, and vegetarian diets share many of these health benefits (but also carry some risks [50-52]). The prevalence of vegetarianism in a highly health-educated population, such as medical students, may provide a benchmark for such health habits in young adults. Though the prevalence of vegetarianism was higher among US medical students than among other young US adults, the percentage of medical student vegetarians decreased during their training. In addition,

although freshmen vegetarians were more likely to think that nutrition counseling would be highly relevant to their intended specialty, by ward orientation their opinion on the relevance of such counseling was indistinguishable from that of their omnivorous peers. Regarding counseling frequency, our sample was not large enough to detect true variation between vegetarians and nonvegetarians. Fewer than 210 senior students of any dietary regimen reported usually/always counseling on nutrition issues. Among the 6% of seniors who reported being vegetarian, only 13% (n=10) also reported frequently providing nutrition counseling to their typical general medicine patients. Although documenting the association between nutrition counseling and vegetarianism may merit larger studies, we found that vegetarian (vs omnivorous) medical students were less likely to be overweight, more likely to eat more fruits and vegetables, and somewhat less likely to binge drink or use tobacco.

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References

1. Key TJ, Fraser GE, Thorogood M, Appleby PN, Beral V, Reeves G, Burr ML, Chang-Claude J, Frentzel-Beyme R, Kuzma JW, Mann J, McPherson K. Mortality in vegetarians and non-vegetarians: A collaborative analysis of 8,300 deaths among 76,000 men and women in five prospective studies. *Public Health Nutr.* 1998;1:33-41.
2. White RF, Seymour J, Frank E. Vegetarianism among US women physicians. *J Am Diet Assoc.* 1999; 99:595-598.
3. Li D, Sinclair A, Mann N, Turner A, Ball M, Kelly F, Abedin L, Wilson A. The association of diet and thrombotic risk factors in healthy male vegetarians and meat-eaters. *Eur J Clin Nutr.* 1999;53:612-619.
4. Appleby PN, Davey GK, Key TJ. Hypertension and blood pressure among meat eaters, fish eaters, vegetarians, and vegans in EPIC-Oxford. *Public Health Nutr.* 2002;5:645-654.
5. Jenkins DJ, Kendall CW, Marchie A, Jenkins AL, Augustin LS, Ludwig DS, Barnard ND, Anderson JW. Type 2 diabetes and the vegetarian diet. *Am J Clin Nutr.* 2003;78(suppl 3):610S-616S.
6. Snowdon DA, Phillips RL. Does a vegetarian diet reduce the occurrence of diabetes? *Am J Public Health.* 1985;75:507-512.
7. Fonnebo V. The healthy Seventh-day Adventist lifestyle: What is the Norwegian experience? *Am J Clin Nutr.* 1994;59(suppl 5):1124S-1129S.
8. Nicholson AS, Sklar M, Barnard ND, Gore S, Sullivan R, Browning S. Toward improved management of NIDDM: A randomized, controlled, pilot intervention using a lowfat, vegetarian diet. *Prev Med.* 1999;29: 87-91.
9. Barnard ND, Scialli AR, Bertron P, Hurlock D, Edmonds K, Talev L. Effectiveness of a low-fat vegetarian diet in altering serum lipids in healthy premenopausal women. *Am J Cardiol.* 2000;85:969-972.
10. McDougall J, Bruce B, Spiller G, Westerdahl J, McDougall M. Effects of a very low-fat, vegan diet in subjects with rheumatoid arthritis. *J Alt Complement Med.* 2002;8:71-75.
11. Donaldson MS, Speight N, Loomis S. Fibromyalgia syndrome improved using a mostly raw vegetarian diet: An observational study. *BMC Complement Alt Med.* 2001;1:7.
12. Frank E, Wright EH, Serdula MK, Elon LK, Baldwin G. US women physicians' personal and clinical nutrition-related practices. *Am J Clin Nutr.* 2002;75:326-332.
13. Fraser G. Associations between diet and cancer, ischemic heart disease, and all-cause mortality in non-Hispanic white California Seventh-day Adventists. *Am J Clin Nutr.* 1999;70(suppl 3):532S-538S.
14. Shea S, Basch CE, Zybert P. Correlates of internists' practices in caring for patients with elevated serum cholesterol. *Am J Health Promot.* 1990;4:421-428.
15. Spencer EH, Frank E, Elon LK, Hertzberg VS, Galuska D, Serdula MK. Predictors of nutrition counseling behaviors and attitudes among US medical students. *Am J Clin Nutr.* 2006;84:655-662.
16. Hyman D, Maibach EW, Flora JA, Fortmann SP. Cholesterol treatment practices of primary care physicians. *Public Health Rep.* 1992;107:441-448.
17. Ammerman AS, DeVellis RF, Carey TS, Keyserling TC, Strogatz DS, Haines PS, Simpson RJ Jr, Siscovick DS. Physician-based diet counseling for cholesterol reduction: Current practices, determinants, and strategies for improvement. *Prev Med.* 1993;22:96-109.
18. Levine BS, Wigren MM, Chapman DS, Kerner JF, Bergman RL, Rivlin RS. A national survey of attitudes and practices of primary-care physicians relating to nutrition: Strategies for enhancing the use of clinical nutrition in medical practice. *Am J Clin Nutr.* 1993;57:115-119.
19. Frank E. The Women Physicians' Health Study: Background, objectives, and methods. *J Am Med Womens Assoc.* 1995;50:64-66.
20. Heimburger D, Ullmann D, Ramsey MJ, Wooldridge NH, Epps LA, Hardin JM, Hsu C. Dietary habits of first-year medical students assessed during clinical nutrition course. *Nutrition.* 1994;10:214-220.
21. Kolasa K, Jobe AC, Miller MG, Clay MC. Teaching medical students cancer risk reduction nutrition counseling using a multimedia program. *Fam Med.* 1999;31:200-204.
22. Kann P, Lane DS. Breast cancer screening knowledge and skills of students upon entering and exiting a medical school. *Acad Med.* 1998;73:904-906.
23. Frank E. Physician health and patient care. *JAMA.* 2004;291:637.
24. American Association of Medical Colleges. AAMC data warehouse: Total enrollment by gender and race/ethnicity, 1992-2001. Available at: <http://www.aamc.org/data/facts/archive/famg82001.htm>. Accessed July 13, 2004.
25. National Institutes of Health. Support to US medical schools, fiscal year 2000. Available at: <http://grants.nih.gov/grants/award/rank/medschrank00.txt>. Accessed July 13, 2004.
26. Stoll M. *The Best Medical Schools, 2000 Edition*. New York, NY: Princeton Review; 1999.

27. American Association of Medical Colleges. Applicant age at anticipated matriculation, 1992-2001. Available at: <http://www.aamc.org/data/facts/archive/famg112001a.htm>. Accessed December 10, 2004.
28. Frank E, Galuska D, Elon L, Wright E. Personal and clinical exercise-related attitudes and behaviors of freshmen US medical students. *Res Q Exerc Sport*. 2004;75:112-121.
29. Block G, Gillespie C, Rosenbaum EH, Jenson C. A rapid food screener to assess fat and fruit and vegetable intake. *Am J Prev Med*. 2000;18:284-288.
30. Spencer EH, Elon LK, Hertzberg VS, Stein AD, Frank E. Validation of a brief diet survey instrument among medical students. *J Am Diet Assoc*. 2005;105:802-806.
31. Wright EH. *What Are Medical Students' Personal Dietary Practices, and Are They Associated with Their Clinical Attitudes and Practices of Counseling in Nutrition?* [dissertation]. Atlanta, GA: Emory University Graduate School of Arts & Sciences; 2004.
32. Frank E, McLendon L, Elon LK, Denniston M, Fitzmaurice D, Hertzberg V. Medical students' self-reported typical counseling practices are similar to those assessed using Standardized Patients. Available at: <http://www.medscape.com/viewarticle/497041>. Accessed November 20, 2006.
33. Vegetarian Resource Group. How many vegetarians are there? A 2000 National Zogby Poll sponsored by the Vegetarian Resource Group (VRG). Available at: www.vrg.org/nutshell/poll2000.htm. Accessed August 17, 2005.
34. Vegetarian Resource Group. How many vegetarians are there? A 2003 national Harris Interactive survey question. Available at: <http://www.vrg.org/journal/vj2003issue3/vj2003issue3poll.htm>. Accessed August 20, 2005.
35. Spencer EH, Bendich A, Frank E. Vitamin and mineral supplement use among US medical students: A longitudinal study. *J Am Diet Assoc*. 2006;106:1975-1983.
36. Frank E, Carrera J, Elon LK, Hertzberg VS. Basic demographics, health practices, and health status of US medical students. *Am J Prev Med*. In press.
37. Crapse F, Hudgins PM, Baker HH. Lifestyle changes associated with osteopathic medical education. *J Am Osteopath Assoc*. 1993;93:1051-1054.
38. Hung HC, Joshipura KJ, Jiang R, Hu FB, Hunter D, Smith-Warner SA, Colditz GA, Rosner B, Spiegelman D, Willett WC. Fruit and vegetable intake and risk of major chronic disease. *J Natl Cancer Inst*. 2004;96:1577-1584.
39. New SA. Intake of fruits and vegetables: Implications for bone health. *Proc Nutr Soc*. 2003;62:889-899.
40. Martinez ME. Primary prevention of colorectal cancer: Lifestyle, nutrition, exercise. *Recent Results Cancer Res*. 2005;166:177-211.
41. van Dam RM, Rimm EB, Willett WC, Stampfer MJ, Hu FB. Dietary patterns and risk for type 2 diabetes mellitus in US men. *Ann Intern Med*. 2002;136:201-209.
42. Newby PK, Muller D, Hallfrisch J, Qiao N, Andres R, Tucker KL. Dietary patterns and changes in body mass index and waist circumference in adults. *Am J Clin Nutr*. 2003;77:1417-1425.
43. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, Marks JS. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA*. 2003;289:76-79.
44. Putnam SD, Cerhan JR, Parker AS, Bianchi GD, Wallace RB, Cantor KP, Lynch CF. Lifestyle and anthropometric risk factors for prostate cancer in a cohort of Iowa men. *Ann Epidemiol*. 2000;10:361-369.
45. Garaulet M, Marin C, Perez-Llamas F, Canteras M, Tebar FJ, Zamora S. Adiposity and dietary intake in cardiovascular risk in an obese population from a Mediterranean area. *J Physiol Biochem*. 2004;60:39-49.
46. US Department of Health and Human Services, Centers for Disease Control and Prevention. Healthy People 2010 Database. Available at: <http://www.healthypeople.gov/data/data2010.htm>. Accessed November 8, 2003.
47. Popkin BM. The nutrition transition and its health implications in lower-income countries. *Public Health Nutr*. 1998;1:5-21.
48. World Health Organization, International Agency for Research on Cancer. *Weight Control and Physical Activity*. Vol 6. Lyon, France: IARC Press; 2002.
49. Horrocks P, Blackmore R, Wright AD. A long-term follow-up of dietary advice in maturity-onset diabetes: The experience of one centre in the UK Prospective Study. *Diab Med*. 1987;4:241-244.
50. Bissoli L, Francesco VD, Ballarin M, Mandragona R, Trespido R, Brocco G, Caruso B, Bosello O, Zamboni M. Effect of vegetarian diet on homocysteine levels. *Ann Nutr Metab*. 2002;46:73-79.
51. Dwyer J. Convergence of plant-rich and plant-only diets. *Am J Clin Nutr*. 1999;70 (suppl):620-622.
52. Krajcovicova-Kudlackova M, Buckova K, Klimes K, Sebkova E. Iodine deficiency in vegetarians and vegans. *Ann Nutr Metab*. 2003;47:183-185.