Physical Health: Nutrition

Dietary Patterns of Men and Women Suggest Targets for Health Promotion: The Framingham Nutrition Studies

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Abstract

Purpose. *The goal of the study was to characterize the dietary patterns of adult men and women.*

Design. *The study used a cross-sectional analysis of food consumption behaviors and nutrient intake measured from 1984 through 1988.*

Setting. *The Framingham Offspring/Spouse Study, Framingham, Massachusetts.*

Subjects. *The population-based sample comprised 1831 men and 1828 women between 20 and 70 years of age.*

Measures. *Dietary patterns were defined by cluster analyses, which used the estimates of usual daily food intake from food frequency questionnaires, and the patterns were compared with Food Guide Pyramid recommendations. Nutrient intakes were independently estimated from 24-hour recalls and compared with Year 2000 nutrition recommendations.*

Results. *Cluster analyses identified five groups of men and five groups of women with distinctive dietary patterns. Men differed on intakes of all food groups except vegetables and snacks plus sweetened beverages. Specific dietary behaviors, including low intakes of whole grains, fruits, vegetables, and other complex carbohydrates; high intakes of beer and liquor; and high intakes of high-fat animal foods warrant targeted intervention messages for men. Women's patterns differed across all food groups except red meats and fattier poultry and beer. Dietary behaviors of women that deserve attention include low fruit, vegetable, starch, and dairy intakes; chronic dieting; high alcohol intake; and sources of hidden fats. No cluster met the current recommendations for food and nutrient intake.*

Conclusions. *Distinct dietary patterns in Framingham men and women vary in compliance with national nutrition and health policy objectives and provide insights for developing behavioral interventions to improve food and nutrient intake. (Am J Health Promot 1996;11[1]:42-53.)*

Key Words: Dietary Behavior Patterns, Nutrient Intake, Chronic Disease Risk, Framingham Study

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INTRODUCTION

Behavioral interventions to improve dietary behaviors are increasingly recognized as important in the treatment and prevention of a variety of chronic diseases, including coronary heart disease, hypertension, stroke, certain cancers, and osteoporosis.[1,2] Since the late 1970s, national population-based nutrition recommendations have emphasized a reduction in dietary lipids and sodium; increases in complex carbohydrates, dietary fiber, fruits, and vegetables; moderation in alcohol consumption; and maintenance of ideal body weight through diet and exercise. The latest nutrition guidelines, called the Year 2000 Nutrition Objectives for the Nation[1] and the Food Guide Pyramid,[2] provide direction for the development of nutrition intervention strategies and specific criteria against which to evaluate population food and nutrient intake.

Previous dietary interventions to lower chronic disease risk have met with limited success. Estimates of long-term compliance with preventive dietary regimens vary considerably, suggesting that as few as 10% of patients overall, but up to 70% of persons in certain high-risk subgroups, achieve and maintain dietary recommendations.[3] The reasons for noncompliance are not fully understood, but resistance has been attributed to consumers' lack of nutrition knowledge, their limited sense of self-efficacy, or a lack of perceived vulnerability to adverse health outcomes.[3,4] Noncompliance has also been linked to the restrictive nature of dietary protocols, the use of primarily didactic education and counseling strategies, a failure to individualize nutrition interventions, the use of nutrient-focused dietary guidance rather than more easily comprehended food-focused messages, and limited availability of appropriate food products in the marketplace and restaurants.[3-5]

The translation of national nutrition objectives into effective population-based strategies for chronic disease risk reduction depends on an understanding of the variations in population eating behavior, insight into the factors that limit adherence to published recommendations for food and nutrient intake, and recognition of the areas where behavioral interventions may need to focus. It is also crucial to identify and understand differences in dietary behaviors between men and women and within subgroups of men and women to guide the development of targeted health promotion campaigns.

This article characterizes patterns of dietary behaviors among Framingham Study men and women in terms of food and nutrient intake, evaluates them in relation to the Food Guide Pyramid and Year 2000 Nutrition Objectives for the nation, and pinpoints problem areas for nutrition intervention planning.

METHODS

Design

The Framingham Heart Study was initiated in 1948 as a longitudinal population-based study of cardiovascular disease, and later, other chronic diseases were added to the study design. The original Framingham cohort consisted of 5209 men and women, who were between 28 and 62 years of age at the beginning of the study and who represented a two-thirds random sample of the residents of Framingham, Massachusetts. In 1971, 5124 Framingham Study offspring and their spouses, who were between 12 and 60 years of age, were recruited to participate in the Framingham Offspring/Spouse study.[6] This report contains cross-sectional information on dietary patterns and nutrient intake profiles of the Offspring/Spouse cohort.

Sample

These data were collected at the third examination (Cycle III) of the Offspring/Spouse cohort from 1984 through 1988. During this period, 1831 men and 1956 women participated in Cycle III examinations, and 1669 (91%) men and 1828 (91%) women contributed complete dietary information for these analyses.

Table 1

Descriptions of Food Group Clusters for Framingham Men and Women

Men	Women
1. *Vegetables* Vitamin A-rich vegetables Vitamin C-rich vegetables Higher-fiber vegetables Other vegetables	1. *Vegetables* Vitamin A-rich vegetables Vitamin C-rich vegetables Higher-fiber vegetables Other vegetables
2. *Diet Beverages and Vegetable Fat* Firm vegetable fats Noncaloric caffeinated beverages	2. *Diet Beverages and Vegetable Fat* Firm vegetable fats Noncaloric caffeinated beverages
3. *Refined Grains and Sweets* Refined grains High-fat desserts Lower-fat desserts Lower-fat sweets	3. *Sweets and Fats* High-fat dairy beverages Butter and creams Lower-fat sweets
4. *Fruits and Whole Grains* Vitamin C-rich fruits Higher-fiber fruits Other fruits Whole grains	4. *Desserts* High-fat desserts Lower-fat desserts High-fat sweets
5. *High-Fat Animal Foods* High-fat dairy products High-fat dairy beverages High-fat meats Eggs Butter and creams	5. *Other Lower-Fat Foods* Lower-fat poultry Fish Whole grains Lower-fat dairy products Lower-fat health foods Lower-fat beverages Noncaloric decaffeinated beverages
6. *Shellfish and Legumes* Shellfish Legumes High-fat health foods	6. *Red Meats* High-fat meats Lower-fat meats Mixed dishes
7. *Low-Fat Animal and Vegetable Foods* Medium-fat dairy beverages Lower-fat dairy products Lower-fat poultry Soft vegetable fats Lower-fat health foods	7. *Fruits and Low-Fat Milk* Medium-fat dairy beverages Vitamin C-rich fruits Higher-fiber fruits Other fruits Liquors
8. *Mixed Protein Dishes* Lower-fat meats Higher-fat poultry Mixed dishes	8. *Sweetened Beverages* Sweet caffeinated beverages Sweet decaffeinated beverages
9. *Fish and Wine* Organ meats Fish Soups Wine	9. *Soups and Miscellaneous* Shellfish Legumes High-fat health foods Soups
10. *Snacks and Sweetened Beverages* Salty or fatty snacks High-fat sweets Sweet caffeinated beverages Sweet decaffeinated beverages	10. *Bread and Margarine* Refined grains Soft vegetable fats
11. *Beer and Other Beverages* Beer Lower-fat beverages Noncaloric decaffeinated beverages	11. *High-Fat Dairy and Snacks* High-fat dairy and cheese Salty or fatty snacks
12. *Distilled Liquors* Distilled liquors	12. *Fattier Poultry and Beer* Higher-fat poultry Beer
	13. *Wine and Cholesterol-Rich Foods* Organ meats Eggs Wine

Measures

Dietary patterns in this study were characterized from data provided by the Framingham food frequency questionnaire.[7] This instrument was patterned after the original Willett food frequency questionnaire[8] and consisted of 145 separate food items. Each food item was classified into 42 food categories (Table 1), which were consistent with the subgroups of foods found in the American Dietetic Association Exchange List for Meal Planning,[9,10] such as lower-fat (3 to 6 gm of fat/ounce) and higher-fat (≥7 gm of fat/ounce) meats and substitutes. The items in a particular food category contained similar levels of macronutrients and other key nutrients; for example, all vitamin A-rich vegetables (≥2500 mg/serving) were grouped into one category, as were vitamin C-rich fruits (≥30 mg/serving).

The food frequency questionnaire directed subjects to estimate their usual intake of a standardized portion of a given food item (e.g., "How often do you usually consume 1 cup of milk *or* 1 serving of chicken without skin?"). Seven, nonoverlapping response categories were provided. They ranged from "rarely or never use" (a food item) to use "four or more times each day." The reported frequencies were used to estimate the subjects' number of usual daily servings of each food item. An estimate of the usual number of daily servings for each of the 42 food categories was also derived by summing across its component foods.

Each subject's nutrient intake was estimated separately from a single 24-hour dietary recall. These interviews were conducted by trained interviewers at the time of the Cycle III clinic visit. Foods consumed during the prior 24 hours were summarized; portions were estimated using a validated[11,12] two-dimensional food portion visual. Dietary recalls were processed by trained coders who used standardized protocols, and nutrient intakes were calculated with the computerized Michigan State nutrient data base (copyright 1984).[13] The 24-hour recall data were used to provide an estimate of group mean nutrient intake. Such estimates have been previously shown in Framingham[7] to compare favorably with means calculated from multiple-day food records.

Analysis

The major objectives of the cluster analyses were threefold: to determine whether different dietary patterns existed among Framingham men and women; to assess whether men and women with differing dietary patterns varied in terms of food and nutrient intake; and to evaluate the extent to which these groups of men and women adhered to published dietary recommendations to provide direction for health promotion intervention planning.

Factor Analysis of Food Behaviors. To determine dietary patterns, a two-step approach was used. First, the groups of foods (from the 42 food categories) that men and women consumed in a similar fashion were identified with the VARCLUS procedure in the SAS program,[14] which employed a clustering method of grouping variables.[15] The intent of this procedure was to identify a limited number of food groups that could be more easily incorporated into subsequent analyses. The VARCLUS procedure is similar to a factor analysis[15] of the 42 food categories, with the added requirement that foods are divided into nonoverlapping groups. This clustering of variables was performed separately for men and women, because it was assumed that dietary patterns probably would differ by gender. This procedure compared foods according to their usual frequency of consumption, not by

Table 2

Mean Daily Food Group Consumption Levels of Clustered Framingham Men

	Subject Cluster					
Food Groups	Cluster I-M n = 949 Mean (95% CI)*	Cluster II-M n = 215 Mean (95% CI)	Cluster III-M n = 334 Mean (95% CI)	Cluster IV-M n = 117 Mean (95% CI)	Cluster V-M n = 54 Mean (95% CI)	All Men n = 1669 Mean (95% CI)
Vegetables	2.62 (2.53-2.70)	2.54 (2.36-2.72)	2.40 (2.27-2.53)	2.57 (2.36-2.79)	2.67 (2.34-2.99)	2.56 (2.50-2.62)
Diet bevs. & veg. fat†	3.40 (3.27-3.54)	<u>3.95 (3.68-4.22)</u>	3.11 (2.92-3.29)	3.38 (3.08-3.68)	**2.56 (2.15-2.97)**	3.39 (3.29-3.48)
Refined grains & sweets	4.77 (4.58-4.95)	<u>5.66 (5.27-6.05)</u>	4.22 (3.91-4.53)	4.75 (4.21-5.29)	**3.71 (3.12-4.30)**	4.74 (4.60-4.89)
Fruits & whole grains	<u>3.44 (3.30-3.59)</u>	2.89 (2.58-3.21)	2.76 (2.54-2.97)	2.56 (2.22-2.90)	2.81 (2.29-3.33)	3.15 (3.05-3.26)
High-fat animal foods	2.21 (2.13-2.30)	<u>6.29 (6.04-6.54)</u>	2.28 (2.12-2.43)	2.85 (2.49-3.20)	2.06 (1.74-2.37)	2.79 (2.69-2.89)
Shellfish & legumes	0.10 (0.09-0.11)	**0.08 (0.07-0.09)**	**0.08 (0.07-0.09)**	0.10 (0.08-0.11)	<u>0.13 (0.10-0.15)</u>	0.09 (0.09-0.10)
Low-fat a&v foods†	<u>2.12 (2.01-2.22)</u>	**1.53 (1.34-1.72)**	1.79 (1.64-1.94)	1.76 (1.49-2.02)	1.74 (1.37-2.11)	1.94 (1.86-2.01)
Mixed protein dishes	0.43 (0.41-0.45)	<u>0.49 (0.46-0.52)</u>	**0.37 (0.35-0.40)**	0.42 (0.38-0.47)	0.45 (0.39-0.51)	0.43 (0.41-0.44)
Fish & wine	0.62 (0.59-0.65)	**0.46 (0.42-0.50)**	0.55 (0.50-0.59)	0.71 (0.62-0.81)	<u>2.86 (2.71-3.02)</u>	0.66 (0.63-0.69)
Snacks & sweet bevs.	1.40 (1.32-1.49)	1.55 (1.39-1.71)	1.12 (1.01-1.23)	1.29 (1.07-1.51)	0.97 (0.76-1.18)	1.34 (1.28-1.40)
Beer & other bevs.	**0.86 (0.79-0.92)**	1.16 (0.98-1.33)	<u>3.70 (3.54-3.85)</u>	1.41 (1.16-1.66)	1.73 (1.33-2.13)	1.53 (1.45-1.61)
Distilled liquor	0.15 (0.13-0.17)	0.13 (0.09-0.16)	0.16 (0.13-0.20)	<u>2.79 (2.68-2.90)</u>	0.44 (0.27-0.61)	0.35 (0.31-0.38)

* Mean servings per day. The variability in mean servings per day among clusters is shown in the table; means that are notably higher are underlined, and means that are notably lower are in bold.
† bevs. = beverages; veg. = vegetable; a&v = animal & vegetable.

consumption at similar times of day, at the same meal, or in similar quantities. The foods that were grouped together had a similar pattern of intake (i.e., relatively high or low intake).

With the method described above, 12 food groups were identified for men, and 13 groups were identified for women; each group contained multiple food items (see Table 1). The food groups contained foods that men and women may not typically have eaten at the same time or meal (e.g., diet beverages and vegetable fats) but that were consumed at similar levels compared with other men or women. For example, we found that men who reported relatively high daily intakes of high-fat dairy beverages and products also reported relatively high daily intakes of high-fat meats, eggs, butter, and cream; conversely, men who reported relatively low intakes of high-fat dairy products also reported relatively low intakes of the other items in this food group.

Cluster Analysis of Individuals. After grouping foods by their frequency of intake, the second step in determining dietary patterns was to identify clusters of men and women who had similar intakes of these foods. This was done using Ward's clustering approach,[16] implemented in the Cluster procedure in SAS.[14] This method considered how Framingham men and women differed in their consumption of the 12 or 13 food groups, respectively, and used the pseudo-t^2 statistic to identify the optimal number of clusters of men and women with distinctive food consumption patterns. The pseudo-t^2 statistic is a criterion for determining the number of clusters. It is plotted against the number of potential clusters, and when it changes little, it is concluded that adding clusters does not provide a better fit to the data.

Comparison With Dietary Recommendations. After the clusters (groups) of men and women with different food consumption patterns were identified, each cluster's mean daily consumption (i.e., number of servings) of the 12 or 13 food groups was computed. Daily food intake was compared with the recommendations set forth by the Food Guide Pyramid.[2] For this comparison, we computed each cluster's mean daily servings of foods in the six Pyramid food categories: fats, oils, and sweets group; milk, yogurt, and cheese group; vegetable group; fruit group; meat, poultry, fish, dry beans, eggs, and nuts group; and bread, cereal, rice, and pasta group. Although the Pyramid does not consider certain dietary components, such as alcoholic beverages and mixed dishes, each cluster's mean daily servings of alcohol (i.e., beer, wine, and other alcoholic beverages); other beverages (i.e., noncaloric caffeinated and decaffeinated beverages); and other foods (i.e., mixed dishes, soups, and lower-fat health foods) were computed. To identify the clusters that consumed comparatively higher or lower levels of these food groups, analysis of variance was used (Tables 2-5). The significance values (p) from this analysis are not reported because the clusters were derived from the food consumption patterns and were defined by differences in intake levels of food groups.

Independent Estimate of Nutrient Intake. We estimated the age-adjusted mean nutrient intake levels for each cluster of men and women using the 24-hour recalls. Gender-specific cluster differences in nutrient intake were compared by analysis of covariance.

Table 3

Mean Daily Food Group Consumption Levels of Clustered Framingham Women

	Subject Cluster					
Food Groups	**Cluster I-W n = 370 Mean (95% CI)***	**Cluster II-W n = 872 Mean (95% CI)**	**Cluster III-W n = 366 Mean (95% CI)**	**Cluster IV-W n = 64 Mean (95% CI)**	**Cluster V-W n = 156 Mean (95% CI)**	**All Women n = 1828 Mean (95% CI)**
Vegetables	2.75 (2.61-2.88)	2.59 (2.51-2.67)	3.91 (3.70-4.11)	3.16 (2.80-3.52)	2.55 (2.33-2.77)	2.90 (2.83-2.97)
Diet bevs. & veg. fat†	4.17 (3.97-4.37)	3.37 (3.23-3.51)	**2.44 (2.24-2.64)**	3.49 (3.09-3.89)	3.54 (3.23-3.86)	3.36 (3.27-3.46)
Sweets & fats	4.45 (4.22-4.68)	**1.05 (0.98-1.12)**	1.12 (0.99-1.24)	1.75 (1.28-2.23)	2.49 (2.16-2.82)	1.90 (1.80-1.99)
Desserts	1.25 (1.14-1.35)	1.15 (1.06-1.23)	0.85 (0.77-0.93)	**0.58 (0.41-0.75)**	1.30 (1.13-1.46)	1.10 (1.05-1.15)
Other lower-fat foods	**2.44 (2.27-2.62)**	2.75 (2.63-2.87)	5.07 (4.79-5.34)	2.79 (2.36-3.22)	3.06 (2.69-3.42)	3.18 (3.08-3.28)
Red meats	0.88 (0.82-0.94)	0.70 (0.68-0.73)	0.72 (0.67-0.76)	0.80 (0.69-0.92)	0.92 (0.84-0.99)	0.76 (0.74-0.78)
Fruits & low-fat milk	2.39 (2.23-2.54)	2.45 (2.36-2.54)	4.33 (4.10-4.56)	2.44 (2.07-2.82)	2.56 (2.31-2.80)	2.82 (2.74-2.91)
Sweetened beverages	0.34 (0.29-0.39)	0.27 (0.24-0.30)	0.30 (0.25-0.35)	0.23 (0.15-0.31)	2.74 (2.58-2.90)	0.50 (0.46-0.54)
Soups & misc.	0.19 (0.17-0.20)	0.19 (0.18-0.20)	0.36 (0.33-0.40)	0.22 (0.18-0.26)	0.21 (0.18-0.24)	0.23 (0.22-0.24)
Bread & margarine	3.66 (3.42-3.91)	**2.61 (2.51-2.71)**	3.42 (3.23-3.61)	2.86 (2.41-3.32)	2.96 (2.67-3.24)	3.02 (2.94-3.11)
High-fat dairy & snacks	0.67 (0.62-0.71)	0.78 (0.73-0.82)	0.69 (0.64-0.75)	0.92 (0.76-1.08)	0.79 (0.70-0.88)	0.74 (0.72-0.77)
Fattier poultry & beer	0.14 (0.12-0.16)	0.20 (0.17-0.22)	0.12 (0.10-0.14)	0.15 (0.09-0.20)	0.16 (0.12-0.19)	0.16 (0.15-0.18)
Wine & chol.-rich foods	0.36 (0.33-0.39)	0.46 (0.43-0.48)	0.43 (0.39-0.46)	2.77 (2.66-2.89)	0.34 (0.30-0.39)	0.50 (0.48-0.53)

*Mean servings per day. The variability in mean servings per day among clusters is shown in the table; means that are notably higher are underlined, and means that are notably lower are in bold.
† bevs. = beverages, veg. = vegetables, chol. = cholesterol.

RESULTS

Within the Framingham population, five clusters of men and five clusters of women with distinctive dietary patterns were identified. Their mean daily servings of the 12 (men) and 13 (women) food groups are displayed in Tables 2 and 3. For each gender, the five clusters are evaluated in terms of the Food Guide Pyramid daily recommendations in Tables 4 and 5. Age-adjusted mean nutrient intake levels are compared across clusters of men and women in Tables 6 and 7, respectively. To avoid introducing a bias because of our interpretation of the dietary patterns of the individuals comprising each cluster, we chose not to assign descriptive labels. Instead, subject clusters were identified by group number (I through V) and by sex (M and W).

Dietary Patterns of Framingham Men

Among the five clusters of Framingham men, there were notable differences in daily intakes of 10 of the 12 food groups, excluding vegetables and snacks (see Table 2). The clusters also differed in their daily intakes of Food Guide Pyramid food groups, except breads and vegetables (see Table 4). Their intakes of alcohol and diet beverages also differed.

Cluster I-M comprised the largest group (n = 949, 57% of the population). Unlike other clusters of men, they had the highest mean daily intakes of fruits and whole grains and low-fat animal and vegetable foods (see Table 2). They also had the lowest consumption of beer and noncaloric beverages without caffeine (e.g., decaffeinated noncaloric coffees and teas, diet decaffeinated sodas). This cluster was distinctive in terms of its relatively high daily intake of the Pyramid fruit group and its relatively low consumption of alcohol, particularly beer (see Table 4). They consumed 2 servings of fruit per day and less than 1 serving of alcohol, compared with less than 2 servings of fruit and 1 to 4 daily servings of alcohol in the other clusters.

Men in Cluster II-M (n = 215, 13% of the population) were distinctive in terms of their high mean daily consumption of diet beverages, vegetable fats, refined grains and sweets, high-fat animal foods, and mixed dishes (see Table 2). Their daily intakes of shellfish, other fish, legumes, wine, and low-fat animal and vegetable foods were relatively low in comparison with other clusters. Their intakes of Pyramid food groups were distinctive in terms of higher daily intakes of milk, yogurt, and cheese (2.5 daily servings, compared with 1 to 1.5 servings in the other clusters); meat, poultry, fish, and alternatives (2.65 daily servings, compared with 1.63 to 1.92 servings); and fat, oils, and sweets (8.76 daily servings, compared with 5 to 6.4 servings). They also had relatively lower alcohol intakes (<1 daily serving).

Cluster III-M (n = 334, 20% of the population) had the highest mean daily consumption of beer and other beverages and the lowest daily intake of shellfish and legumes and of mixed dishes, such as sandwiches or casseroles (see Table 2). Their daily consumption of Pyramid groups was not distinctive relative to the other clusters; however, they consumed more "other beverages" than the other clusters (>4 daily servings, compared with <3.5 servings in the other clusters).

Cluster IV-M (n = 117, 7% of the population) had mean daily distilled liquor intakes that were more than 6-fold greater than those of the other clusters; the IV-M group had about 3 servings per day, compared with less than 0.5 serving per day in the other

Table 4

Dietary Patterns Among Clustered Framingham Men Evaluated in Terms of the Food Guide Pyramid

	Subject Cluster					
Food Groups	Cluster I-M n = 949 Mean*	Cluster II-M n = 215 Mean	Cluster III-M n = 334 Mean	Cluster IV-M n = 117 Mean	Cluster V-M n = 54 Mean	All Men n = 1669 Mean
Food Guide Pyramid Category						
Bread/cereal/rice/pasta (6-11)†	3.62	3.79	3.32	3.42	3.09	3.55
Vegetables (3-5)	2.62	2.54	2.40	2.57	2.67	2.56
Fruits (2-4)	2.18	1.66	1.61	1.51	1.73	1.94
Milk/yogurt/cheese (2-3)	1.50	2.51	1.51	1.34	1.04	1.61
Meat/poultry/fish‡ (2-3)	1.74	2.65	1.74	1.92	1.63	1.87
Fats/oils/sweets (sparingly)	6.29	8.76	5.45	6.40	4.99	6.40
Other Food Groups						
Other foods§	0.50	0.50	0.44	0.47	0.57	0.49
Other beverages‖	2.99	3.42	4.27	3.12	2.94	3.31
Alcoholic beverages	**0.69**	0.91	1.80	3.86	3.47	1.25

*Mean servings per day. The variability in mean servings per day among clusters is shown in the table; means that are notably higher are underlined, and means that are notably lower are in bold.
† The Food Guide Pyramid recommended number of servings is shown in parentheses.
‡ This also includes beans, eggs, and nuts.
§ Other foods: mixed dishes, soups, lower-fat "health" foods.
‖ Other beverages: noncaloric caffeinated beverages and noncaloric decaffeinated beverages.

clusters (see Table 2). Cluster IV-M dietary patterns were not distinct from the others in terms of daily intakes of the Pyramid groups, but their intake of all types of alcoholic beverages was high (3.86 alcoholic drinks/day, compared with <2 drinks in Clusters I-M, II-M, and III-M and 3.47 drinks/ day in Cluster V-M).

Cluster V-M, the smallest male group (n = 54, 3% of the population), consumed the highest daily servings of fish and wine and of shellfish and legumes, and they consumed the lowest levels of refined grains and sweets and of diet beverages and vegetable fat (see Table 2). Their daily intakes of Pyramid foods were not distinctive, but their daily alcohol intake, particularly wine, was relatively high (3.47 daily servings of alcohol) compared with other clusters.

Table 6 compares the nutrient intake levels of the five clusters of men. The five clusters differed in levels of intake of the following nutrients: calories (range of means, 2280 to 2540 calories), carbohydrates (36.2% to 43.0% of energy), total fat (33.1% to 42.2%), saturated (13.2% to 15.5%), oleic (10.8% to 12.7%) and linoleic fatty acids (4.54% to 5.21%), alcohol (2.45% to 11.2%), and cholesterol (355.4 to 487.2 mg).

Cluster I-M had the highest daily carbohydrate intake (43% of calories). Cluster II-M had the highest daily calorie intake and consumed the highest amounts of total (42.2%), saturated (15.5%) and monounsaturated (oleic, 12.7%) fat, and cholesterol (487.2 mg). Cluster III-M was not distinctive from the other groups in terms of nutrient intake. Cluster IV-M had the lowest carbohydrate intake (36.2%) and the highest alcohol intake (11.2%). Cluster V-M consumed the lowest level of total fat (33.1%) and saturated fat (11.7%) but had high alcohol intake (11.0%).

Year 2000 Objectives recommend that fats be limited to 30% of energy or less, that saturated and monounsaturated fat be reduced to less than 10% of energy, that carbohydrates be increased to 50% of energy or more, and that alcohol, if used, be consumed in moderation. Compared with these nutrition guidelines (see Table 6), intakes of total fat (33% to 42% of calories), saturated fat (11.7% to 15.5%), and monounsaturated fat (10.8% to 12.7%) were high for all groups of men, and carbohydrate intakes (36% to 43%) were relatively low. Although there is no specific guideline, alcohol intake was relatively high in Clusters III-M (6.2% of calories), IV-M (11.2%), and V-M (11%), but these clusters differed in their distribution of macronutrient intakes. Cluster V-M appeared to have replaced fat intake (33%) with alcohol. Cluster IV-M appeared to have substituted alcohol (11.2% of energy intake) for carbohydrates (36.2%). In addition to macronutrient intake, dietary cholesterol intakes (355 to 487 mg) and sodium consumption (exclusive of added salt) from foods (3.1 to 3.6 g) were higher than recommended levels.

Dietary Patterns of Framingham Women

Among the five clusters of Framingham women, there were important differences in the daily intakes of all 13 food groups, except red meats, and fattier poultry and beer; the latter food group was consumed in particularly low amounts by all clusters of women (see Table 3). The clusters also differed in terms of their daily intakes of all Pyramid food groups (see Table 5).

Cluster I-W (n = 370, 20% of women) was characterized by higher mean daily consumption of diet beverages; vegetable fats, including margarine; breads; and sweets and

Table 5

Dietary Patterns Among Clustered Framingham Women Evaluated in Terms of the Food Guide Pyramid

Food Groups	Subject Cluster					
	Cluster I-W n = 370 Mean*	Cluster II-W n = 872 Mean	Cluster III-W n = 366 Mean	Cluster IV-W n = 64 Mean	Cluster V-W n = 156 Mean	All Women n = 1828 Mean
Food Guide Pyramid Category						
Bread/cereal/rice/pasta (6-11)†	3.45	**2.79**	3.73	2.91	2.94	3.13
Vegetables (3-5)	2.75	2.59	3.91	3.16	2.55	2.90
Fruits (2-4)	1.82	1.85	3.32	1.81	1.93	2.14
Milk/yogurt/cheese (2-3)	1.60	1.38	2.09	1.39	1.45	1.57
Meat/poultry/fish‡ (2-3)	1.48	**1.44**	1.60	1.81	1.60	1.50
Fats/oils/sweets (sparingly)	7.90	**4.23**	4.52	4.28	8.35	5.39
Other Food Groups						
Other foods§	0.45	**0.42**	0.81	0.44	0.47	0.51
Other beverages‖	3.93	3.40	3.33	3.73	3.94	3.55
Alcoholic beverages	**0.32**	0.49	0.46	2.65	0.38	0.51

*Mean servings per day. The variability in mean servings per day among clusters is shown in the table; means that are notably higher are underlined, and means that are notably lower are in bold.

†The Food Guide Pyramid recommended number of servings is shown in parentheses.

‡This also includes beans, eggs, and nuts.

§Other foods: mixed dishes, soups, lower-fat "health" foods.

‖Other beverages: noncaloric caffeinated beverages and noncaloric decaffeinated beverages.

other fats (see Table 3). Their daily consumption of sweets and fats was two to four times higher than the other clusters. Their daily consumption of lower-fat foods was lower than that of the other clusters. According to Pyramid guidelines, Cluster I-W consumed more bread and other starches (3.5 daily servings) than all other clusters, except Cluster III-W, and consumed more fats, oils, and sweets (7.9 daily servings) than all clusters, except Cluster V-W. These women also consumed the lowest level of alcohol.

Cluster II-W (n = 872, 48% of women) consumed the lowest daily amounts of sweets, other fats, and bread and margarine (see Table 3). Compared with the Food Guide Pyramid, their intakes of most foods were relatively low and were lowest for fats, oil, and sweets; breads and starches; and meats and their alternatives. Their intakes of "other foods" (e.g., mixed dishes) were also lowest.

Cluster III-W (n = 366, 20% of women) consumed more vegetables, lower-fat foods, fruits, lower-fat dairy products, and soups, and they consumed fewer diet beverages and vegetable fats on a daily basis than the other clusters (see Table 3). By the Food Guide Pyramid standards, they consumed more breads and other starches (3.73 daily servings), vegetables (3.91 daily servings), fruit (3.32 daily servings), and dairy products (2.09 daily servings). Their intakes of other foods (0.81 daily servings), such as mixed dishes and lower-fat foods, were also higher than those of the other clusters of women.

Cluster IV-W (n = 64, 3.5% of women) consumed more high-fat dairy foods and snack items and more wine and cholesterol-rich foods, such as eggs and organ meats, on a daily basis, but they consumed lower amounts of desserts (see Table 3). Their daily intakes of meats and alternatives (1.81 daily servings) were relatively high (see Table 5); their alcohol consumption (2.65 daily servings) was about fourfold to ninefold higher than the other clusters.

Cluster V-W (n = 156, 8.5% of women) consumed daily about 10 times more sweetened beverages than the other women. Their intakes of fats, oils, and sweets, as defined by Pyramid servings, were also highest (8.35 daily servings).

Considering the food intakes of Framingham women (see Table 5), none of the clusters met the Food Guide Pyramid criteria for breads, cereals, rice, and pasta intake, and only one or two clusters met the criteria for dairy foods (Cluster III-W), fruit (Cluster III-W), or vegetables (Clusters III-W and IV-W), albeit with intakes at the low end of the recommended ranges. Daily intakes of breads and other starches, which ranged from 2.79 to 3.73 servings per day, fell below the recommended 6 to 11 daily servings. Vegetable intakes ranged from 2.55 to 3.91 servings per day and were often below the 3 to 5 recommended servings. Fruit intakes ranged from 1.81 to 3.32 servings per day, compared with 2 to 4 recommended servings. Dairy intakes ranged from 1.38 to 2.09 daily servings, compared with 2 to 3 recommended servings. Consumption of meat and alternative protein sources was relatively low (1.44 to 1.81 daily servings). Intakes of fats, oils, and sweets ranged from 4.23 to 8.35 servings per day. Although not included in the Food Pyramid, alcohol intake was low (0.32 to 0.49 daily servings) in all but Cluster IV-W (2.65 daily servings).

Table 7 compares the nutrient intake levels across the five clusters of Framingham women. They differed in intake levels of all nutrients except linoleic acid and dietary cholesterol. Compared with other Framingham women, Cluster I-W had relatively high intakes of total fat (40.6% of daily energy intake), saturated fat (14.9%), and monounsaturated fat (oleic acid, 12.3%). Their mean alcohol intake was the lowest (1.37%). Cluster II-W had

Table 6

Age-Adjusted Mean Nutrient Intakes Among Clusters of Framingham Men

	Cluster I-M n = 949 Mean (95% CI)*	Cluster II-M n = 215 Mean (95% CI)	Cluster III-M n = 334 Mean (95% CI)	Cluster IV-M n = 117 Mean (95% CI)	Cluster V-M n = 54 Mean (95% CI)	All Men n = 1669 Mean (95% CI)
Calories†	2280 (2224-2336)	<u>2540 (2421-2659)</u>	2281 (2186-2376)	2312 (2152-2473)	2281 (2043-2521)	2316 (2273-2359)
Percent protein	16.9 (16.6-17.3)	17.1 (16.5-17.8)	16.5 (16.0-17.0)	16.5 (15.6-17.4)	16.6 (15.3-18.00)	16.8 (16.6-17.1)
Percent carbohydrates†	<u>43.0 (42.3-43.7)</u>	39.0 (37.6-40.4)	41.3 (40.2-42.4)	**36.2 (34.4-38.1)**	39.8 (37.0-42.6)	41.6 (41.1-42.1)
Percent fat†	38.5 (37.9-39.1)	<u>42.2 (40.9-43.5)</u>	37.1 (36.1-38.1)	37.3 (35.5-39.0)	**33.1 (30.5-35.7)**	38.4 (38.0-38.9)
Percent saturated fat	13.2 (12.9-13.5)	<u>15.5 (14.9-16.1)</u>	13.2 (12.7-13.7)	13.1 (12.3-14.0)	**11.7 (10.5-13.0)**	13.5 (13.2-13.7)
Percent oleic acid†	12.0 (11.7-12.2)	<u>12.7 (12.1-13.3)</u>	12.0 (11.5-12.4)	11.3 (10.6-12.1)	10.8 (9.65-11.94)	12.0 (11.8-12.2)
Percent linoleic acid†	5.21 (5.02-5.39)	4.76 (4.36-5.16)	4.54 (4.22-4.85)	4.97 (4.44-5.51)	5.05 (4.25-5.85)	4.99 (4.85-5.14)
Percent alcohol†	2.74 (2.35-3.12)	2.45 (1.64-3.27)	6.19 (5.54-6.84)	<u>11.2 (10.1-12.3)</u>	<u>11.0 (9.4-12.6)</u>	4.24 (3.92-4.55)
Cholesterol (mg)†	357.2(340.2-374.3)	<u>487.2(451.0-523.4)</u>	356.6 (327.6-385.6)	346.3 (297.4-395.2)	355.4 (282.4-428.4)	372.8 (359.8-385.9)
Cholesterol (mg/1000 cal)†	155.4(149.1-161.6)	<u>190.5(177.2-203.8)</u>	160.7 (150.0-171.3)	152.4 (134.5-170.4)	149.9 (123.1-176.7)	160.5 (155.8-165.3)
Sodium (mg)	3234 (3123-3345)	3581 (3345-3816)	3140 (2951-3329)	3144 (2826-3464)	3182 (2706-3658)	3252 (3167-3336)
Sodium (mg/1000 cal)	1447 (1409-1485)	1415 (1335-1496)	1427 (1362-1491)	1417 (1309-1526)	1375 (1213-1536)	1435 (1406-1463)

ll mean nutrient intakes are estimated from 24-hour dietary recalls. The variability in mean servings per day among clusters is shown in the table; neans that are notably higher are underlined, and means that are notably lower are in bold.
† $p < .05$ for tests of significant differences among the five groups.

the lowest mean calorie intake (1497 calories). Cluster III-W had the highest protein intake (18.8%) and the lowest total (35.6%), saturated (11.7%), and monounsaturated fat (oleic acid, 10.6%) intake. Cluster IV-W had the highest daily calorie intake (1674 calories). They also consumed the highest amounts of alcohol (9.1%) and lowest levels of carbohydrate (37.5%) and sodium from food sources (1.2 g/1000 calories per day). Cluster V-W had the highest daily carbohydrate intake (45.5%) and the lowest protein intake (16.2%).

When compared with the Year 2000 nutrition-related objectives,[1] intakes of total fat (35% to 41% of calories), saturated fat (11% to 15%), and monounsaturated fat (11% to 12%) were high for all clusters of women, although the cluster means varied in their proximity to published recommendations. Alcohol intake was relatively high for Cluster IV-W. Although mean dietary cholesterol intakes for all clusters of women met published recommendations, sodium intakes were somewhat above the recommended level (see Table 7). We evaluated only sodium derived from food sources, and because our estimates do not account for added salt, actual sodium intakes are likely to be even higher.

DISCUSSION

The results of this study suggest that a single "typical" American eating pattern does not exist and that men and women have differing dietary patterns. For example, although 57% of men and 48% of women were found in one cluster, the remaining individuals were distributed across four separate clusters. These 10 subgroups of men and women had distinctive patterns of dietary behaviors that could be characterized by various food and nutrient intake levels. The 10 clusters of men and women varied in their ability to achieve population-based recommendations for preventive nutrition.

The characterization of dietary patterns of men and women and a comparison with recommended dietary intakes point to important areas for population health promotion. Researchers[1,17-20] have urged that an understanding of the variations in population dietary patterns be considered in the formulation of more targeted nutrition interventions. Nutrition educators also have voiced the need for dietary messages that are food-focused to assist consumers in translating nutrient-based recommendations such as "reduce fat intake to 30% of calories or less" into appropriate food choices and preparation techniques.[5,21-23] Food-focused intervention messages such as those targeting a decrease in the use of butter and margarine and an increase in vegetable consumption have been found to be particularly effective at achieving the desired changes in dietary behavior when used within the context of a worksite nutrition intervention.[5]

The cluster analysis of dietary patterns in Framingham contributes to the goal of developing food-focused intervention messages for use in a variety of settings. This research directly informs practitioners about which areas of the diet are most problematic for men and for women and identifies foods and food groups to target with global messages and behaviorally based dietary interventions. The findings may be applied to populations and to individuals. It has long been recognized that dietary interventions must be tailored to the specific needs of the client.

Our research suggests several targets for dietary intervention. For example, one group of women (I-W) consumed many servings of high-fat foods along with numerous diet beverages, suggesting a pattern in which low-calorie foods are added to an already high fat diet, rather than substituted for higher-fat foods. A

Table 7

Age-Adjusted Mean Nutrient Intakes Among Clusters of Framingham Women

	Cluster I-W n = 370 Mean (95% CI)*	Cluster II-W n = 872 Mean (95% CI)	Cluster III-W n = 366 Mean (95% CI)	Cluster IV-W n = 64 Mean (95% CI)	Cluster V-W n = 156 Mean (95% CI)	All Women n = 1828 Mean (95% CI)
Calories†	1645 (1583-1708)	**1497 (1456-1538)**	1555 (1491-1620)	1674 (1520-1827)	1588 (1490-1686)	1553 (1524-1582)
Percent protein†	16.4 (15.8-17.0)	17.8 (17.4-18.2)	18.8 (18.2-19.5)	17.8 (16.3-19.2)	**16.2 (15.2-17.1)**	17.6 (17.3-17.8)
Percent carbohydrates†	42.5 (41.4-43.6)	42.2 (41.5-42.9)	44.8 (43.6-45.9)	**37.5 (34.8-40.2)**	45.5 (43.8-47.2)	42.9 (42.4-43.4)
Percent fat†	40.6 (39.6-41.6)	38.5 (37.8-39.1)	**35.6 (34.6-36.6)**	36.3 (33.8-38.7)	37.8 (36.3-39.3)	38.2 (37.8-38.7)
Percent saturated fat†	14.9 (14.4-15.3)	12.9 (12.6-13.2)	**11.7 (11.2-12.2)**	12.2 (10.9-13.4)	13.5 (12.7-14.2)	13.1 (12.9-13.3)
Percent oleic acid†	12.3 (11.9-12.8)	11.2 (10.9-11.5)	**10.6 (10.1-11.0)**	11.3 (10.2-12.4)	11.6 (10.9-12.3)	11.4 (11.1-11.6)
Percent linoleic acid	5.34 (4.98-5.70)	5.50 (5.26-5.74)	5.48 (5.10-5.85)	5.58 (4.69-6.47)	5.53 (4.97-6.10)	5.47 (5.30-5.63)
Percent alcohol†	**1.37 (0.88-1.86)**	2.73 (2.41-3.06)	2.28 (1.77-2.79)	9.1 (7.9-10.3)	1.58 (0.81-2.35)	2.48 (2.25-2.71)
Cholesterol (mg)	269.9 (250.3-289.5)	251.8 (238.9-264.8)	253.3 (233.0-273.5)	297.8 (249.5-346.2)	257.4 (226.6-288.1)	257.9 (248.9-266.9)
Cholesterol (mg/1000 cal)	161.9 (150.4-173.4)	171.2 (163.6-178.8)	163.4 (151.5-175.3)	177.9 (149.6-206.3)	162.4 (144.3-180.4)	167.2 (162.0-172.5)
Sodium (mg)	2296 (2179-2412)	2177 (2100-2254)	2289 (2169-2409)	2043 (1756-2329)	2132 (1949-2314)	2215 (2162-2268)
Sodium (mg/1000 cal)†	1438 (1375-1501)	1497 (1456-1539)	1526 (1461-1591)	**1244 (1089-1399)**	1433 (1334-1531)	1476 (1448-1505)

*All mean nutrient intakes are estimated from 24-hour dietary recalls. The variability in mean servings per day among clusters is shown in the table; means that are notably higher are underlined, and means that are notably lower are in bold.
† $p < .05$ for tests of significant differences among the five groups.

major proportion of women (II-W) consumed relatively few calories and few nutrient-dense foods and derived most of their fat intake from "hidden fats" in desserts, high-fat dairy products, snack foods, and fattier poultry. Other groups of men and women consumed high amounts of snack foods (IV-W), alcohol (IV-W, IV-M, V-M), and soft drinks and sweets (V-W). The group of men who had the highest intake of dietary lipids (II-M) had a pattern of high-fat food consumption.

These data also suggest targets for positive nutrition messages that can encourage and support men and women whose diets are in transition toward achieving dietary guidelines. For example, the largest group of men (I-M) had a relatively low alcohol intake with relatively high carbohydrate and fruit intake. One group of women (III-W) who were consuming more vegetables, low-fat foods, fruits, and vegetable fats came the closest to achieving preventive dietary recommendations.[1] These positive patterns of intake should be encouraged while other higher-fat foods are targeted to further lower total and saturated fat intakes.

The health implications of patterns of dietary behaviors that are consistently aberrant with respect to current recommendations and public health nutrition policies are well established.[24-27] There is considerable scientific evidence that dietary patterns, such as those seen in the Framingham Offspring cohort, contribute to higher risk for developing chronic conditions of major concern, including cardiovascular disease, hypertension, cancer, obesity, and osteoporosis. Because postmenopausal women are recognized as a high-risk population, particularly for coronary heart disease,[27] specific dietary interventions for women need to be introduced early in life to maximize preventive benefits. Improvements in diet to achieve patterns that are lower in total and saturated fat, high in nutrient-dense foods, and rich in complex carbohydrates can contribute to the prevention of many cases of chronic disease, including certain cancers.

The identification of multiple dietary patterns in Framingham men and women is consistent with an emerging but limited body of research.[17-20,28] This report is among the first to evaluate population-based dietary patterns in relation to the Food Guide Pyramid. Overall, Framingham men and women failed to achieve the dietary pattern recommended by the Food Guide Pyramid. Intakes of fats, oils, and sweets appeared to be high in all clusters, and alcohol was a particularly important dietary component in two male clusters and one female cluster. Fruit and vegetable intake was low, a finding that is consistent with earlier research; only 10% of the U.S. population surveyed between 1976 and 1980 was consuming the recommended number of servings of fruits and vegetables.[29]

These data suggest the importance of examining eating behaviors among population subgroups when interpreting proximity to published nutrition recommendations. They also suggest that preformed food groups, such as the Food Guide Pyramid, provide insights into some but not all of the important dietary behaviors that differentiate groups of individuals. These behaviors, especially alcohol consumption, are important to consider when developing preventive nutrition interventions. Innovative tools for assessing dietary quality that incorporate nutrient guidelines and food-focused recommendations, such as the U.S. Department of Agriculture's Healthy Eating Index,[30] can also be useful in guiding nutrition-related health promotion activities.

The dietary patterns of these clusters of men and women are substantiated when they are compared with the Year 2000 Nutrition Objectives for the Nation. For example, Cluster II-M (13% of the population) who consumed the highest levels of high-fat animal foods, refined grains, mixed protein dishes, and diet beverages and vegetable fats were found to have the highest intake levels of calories, all fats (except linoleic fatty acids), and cholesterol. The largest male cluster (Cluster I-M; almost 60% of the population) had the highest fruit and whole grain intakes and the highest carbohydrate consumption (43% of energy), albeit high fat intakes (38.5%). The various dietary behaviors among subgroups of men in the population point to the importance of differentiating dietary patterns within population subgroups when formulating preventive nutrition interventions.

It was thought that the consumption of starches, vegetables, meats, and possibly dairy products may have been underestimated in the comparison with Pyramid guidelines by the creation of the "other foods" category for mixed protein dishes (see Tables 4 and 5). However, mixed dishes were consumed with relatively low frequency (ranging from 0.44 to 0.57 daily servings for men and from 0.42 to 0.81 daily servings for women) and do not appear to have contributed to a meaningful underestimation of servings from the Pyramid food groupings presented here.

It was also possible that the number of servings of meats, poultry, and fish consumed by Framingham men and women were underestimated in the Pyramid analysis because of different interpretations of serving sizes. For example, the Pyramid defines 1 serving as 2.5 to 3 ounces of cooked meat. However, the Framingham food frequency questionnaire leaves the serving size to the individual's interpretation by asking about "1 serving" without offering a definition.

The 24-hour recall data were used to determine that the mean serving size of meats and alternatives was 3.9 ounces among Framingham men and 2.9 ounces among Framingham women. It therefore appears that the estimate of meat, poultry, and fish servings was reasonable for women, but the food frequency technique may have somewhat underestimated the number of servings of meats and alternatives among men.

The use of the Framingham food frequency questionnaire in this study to evaluate population eating behaviors appears to be unique. Other investigators have assessed food intake patterns with 24-hour dietary recalls or multiple day diet records. The food frequency method has the advantage of characterizing the individual's habitual food intake over a longer period. The use of a single 24-hour recall for estimating the mean nutrient intake of Framingham men and women was previously shown to compare favorably with estimates of mean intake calculated from 3-day food records.[7]

The age range, 20 to 70 years, of our female sample is a particular strength of this research because prior studies of women's dietary behaviors have used population-based samples of women younger than 50 years of age[31,32] or free-living elderly women.[33,34] Nonetheless, the Framingham Offspring/Spouse cohort is largely Caucasian; about 2% of subjects are minority individuals. Our results therefore are not generalizable to minority population subgroups.

These data were collected between 1984 and 1988, before the most recent population-based dietary recommendations such as the Year 2000 Objectives and the Food Guide Pyramid were published. Although it is important to know how the dietary patterns and nutrient profiles of men and women compare with current guidelines, it is also important to acknowledge that changes in eating habits are likely to have occurred since the 1984 to 1988 period as a result of public policy, educational campaigns, and an overall heightened awareness of the role of diet in the risk for chronic disease. The diets of American and Framingham men and women should be readdressed as newer dietary data become available.

Nevertheless, this research underscores the complexity of dietary behavior in men and women and demonstrates that foods are eaten in identifiable patterns. It raises questions about the common technique in nutrition epidemiologic research of examining associations between single foods (e.g., beef, coffee) and chronic disease risk. In the absence of a plausible biologic mechanism, we suggest that such approaches be abandoned, particularly because a clearer understanding of the complexities of dietary behavior is needed to effectively guide the development of preventive behavioral interventions. It seems most important to consider dietary exposures within the context of the total dietary pattern. Food consumption patterns are shown here to be consistent with nutrient intake profiles and may be able to predict certain chronic disease risk factors within subgroups of men and women.

CONCLUSIONS

Five clusters of men and five clusters of women with distinctive patterns of dietary behavior and various levels of food and nutrient intake were identified within the Framingham population. Most clusters of men and women had dietary patterns characterized by high total fat and saturated fat intake and low consumption of fruits, dairy products, and starches, although the groups differed in terms of their proximity to population-based preventive nutrition recommendations. Consumption of fats, particularly saturated fats and monounsaturated fats from animal sources, exceeded recommendations, and about 30% of men consumed more than three servings of alcohol per day.

These data are helpful to practitioners because they pinpoint food consumption patterns that predict nutrient intake profiles, and they identify gender-specific problem areas to address in intervention programs. If health professionals expect to move a population toward the dietary recommendations, it is important to recognize that different programs and different messages are needed to target the eating behaviors of different groups. Diverse dietary patterns and nutrient intake profiles such as those described in Framingham will be useful to practitioners in designing targeted, behaviorally based nutrition interventions that deal with various patterns of intake, such as chronic dieting and underconsumption of important micronutrients, excessive alcohol consumption, and high fat intake, all of which are associated with risks for chronic diseases in men and women.

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SO WHAT? Implications for Health Promotion Practitioners and Researchers

This study indicates that a variety of dietary behaviors and nutrient intake patterns exist among groups of men and women. Consistent with behavioral stage of change theory, these data suggest that subgroups of men and women differ in their adoption of preventive nutrition guidelines. Combined with other research, there seems to be strong support for the assertion that the diets of a large proportion of American men and women are incongruous with preventive nutrition recommendations set forth by national nutrition policies and guidelines. More targeted, food-focused dietary intervention messages and strategies are needed to facilitate chronic disease risk reduction. Distinct gender-specific messages and health promotion programming appear to be warranted. It is important to consider dietary exposures within the context of the total dietary pattern when conducting population-based nutrition epidemiologic research.

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Commentary

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DIETARY PATTERNS OF ADULT MEN AND WOMEN: THE FRAMINGHAM NUTRITION STUDIES

Following the identification of the associations between diet and disease outcomes of relevance to our population, nutrition scientists and educators have explored a variety of methods for providing dietary guidance that would move the U.S. population in the direction of healthier eating patterns. The authors of this article challenge the common technique used in nutrition epidemiologic research of examining associations between single nutrients or foods (such as beef or fat) and chronic disease risk. In addition, the authors provide methods and a rationale for an alternative strategy of presenting guidance in terms of dietary patterns.

Using cluster analytic techniques, the authors introduce an evaluation method that focuses on patterns of food intake rather than on consumption of single foods. The food group clusters identified in their analyses are similar to those we found using a principal component analysis (PCA) approach. We performed our analyses at two time points, before and after the intervention, and found the dietary patterns to be stable, despite healthful changes that took place as a result of the intervention.[1] These analyses have important implications for population-wide dietary interventions.

First, these analyses suggest that practitioners may be more effective in influencing dietary behavior change by targeting overall patterns of eating. In addition, this analytic technique provides the information needed to give food-focused, rather than nutrient-focused, dietary guidance people can use when they shop for food, prepare foods at home, and eat away from home. Whether planning nutrition education for community channels such as schools, worksites, or supermarkets, or for the nation as a whole, these analyses provide data needed to design comprehensive nutrition education programs that place target foods and nutrients in the context of total diet rather than as a series of disjointed messages focused on foods or nutrients in isolation. Providing dietary guidance as daily patterns offers another advantage; it supports the first principle of nutrition education, which is that whatever is promulgated be characterized by attending to the nutritional adequacy of the total diet.

Second, these analyses provide a basis for tailoring messages to audiences segmented by eating patterns, gender, and common eating practices. With behaviors as complex as eating, it is difficult enough to communicate messages on a one-to-one basis; how is tailoring to dietary patterns and gender to be done for populations? When the population is the target audience, we are not able to match dietary patterns to specific individuals. We can, however, move beyond "one message fits all" by acknowledging different patterns in our educational strategies so that individuals can match the educational messages to their own dietary patterns.

Third, these analyses give us information about *healthful* dietary patterns that can be encouraged and supported in educational strategies. For example, the dietary patterns of women in Cluster III-W were the closest to achieving preventive dietary recommendations. Messages acknowledging this pattern and encouraging further change could provide positive reinforcement and transmit a positive tone.

Fourth, another important finding is that food consumption patterns are shown here to be consistent with nutrient intake profiles. These data give practitioners confidence that if the population adopts behaviors recommended in behavioral, food-focused intervention messages, people will be moving closer to reducing their disease risk and attaining the Year 2000 nutrition objectives.

The authors discuss limitations of these analyses, including the fact that they are based on data collected some time ago, and that the generalizability is limited to a white, non-Latino ethnic group and to one region of the country. The authors do provide details of the method used to conduct these analyses so that other investigators can replicate this research. Both cluster analysis and PCA techniques are computationally intensive and require large databases and, therefore, are not easily implemented in every study or intervention program.

The results of these analyses confirm the commonsense understanding that people eat in habitual patterns and that if researchers and practitioners incorporate a focus on dietary patterns into their evaluation and intervention methods, it might be possible to accelerate the movement of the U.S. population toward the adoption of healthier eating.

Reference

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