The Association between Leisure-Time Physical Activity and Dietary Fat in American Adults

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ABSTRACT

Relations between leisure-time physical activity and dietary fat were examined in a population-based probability sample of 29 672 adults in the 1990 Behavioral Risk Factor Surveillance System. Consumption of 13 high-fat food items and participation in physical activities were measured, and fat and activity scores were calculated. Dietary fat and physical activity were strongly and inversely associated. This association was independent of nine other demographic and behavioral risk factors. Etiologic researchers should consider that diet and physical activity can potentially confound each other, and creators of public health messages that target one behavior should consider including the other. (*Am J Public Health.* 1995;85:240–244)

Introduction

Dietary fat, particularly saturated fat, is implicated as a risk factor for coronary heart disease,[1] whereas physical activity is associated with risk reduction.[2–4] Although some studies have shown a positive association between caloric intake and physical activity,[5–7] only a few studies in selected populations have examined the relation between dietary fat and physical activity.[8–10] We examined this relationship among US adults in a large population-based survey.

Methods

Data for this analysis were from the 1990 Behavioral Risk Factor Surveillance System, which monitors health behaviors related to major causes of death in the United States.[11] We conducted sampling using a multistage-cluster design and random-digit telephone dialing.[12] The median response rate for the survey was 82%. In 1990, 24 states collected data on both physical activity and high-fat foods. From the 38 986 people who granted a Behavioral Risk Factor Surveillance System interview we excluded 2795 (7.2%) because they were Hispanic (3.5%) or their race was neither Black nor White (3.7%), because ethnic foods were not included in the questionnaire. In addition, we excluded 6519 (16.7%) who were missing information on one or more of the study factors. The final study sample consisted of 29 672 people.

The 13-item questionnaire listed the top contributors to dietary fat in US adults, accounting for more than 65% of total intake.[13] The items were hot dogs and lunch meats; bacon and sausage; other pork; hamburgers, cheeseburgers, and meat loaf; other beef; fried chicken; french fries and fried potatoes; cheese and cheese spreads; doughnuts, cookies, cakes, pastries, and pies; salty snacks; butter or margarine on bread or vegetables; eggs; and whole milk. A fat score was created by multiplying the frequency of consumption by the number of grams of fat in a typical portion size and summing across all foods. The nutrient values, portion sizes, and representative food items were population-based values developed by Block et al. using National Health and Nutrition Examination Survey II data and other sources.[14]

Respondents were asked whether they had participated in the past month in any leisure-time physical activity or exercise such as running, calisthenics, golf, gardening, or walking. If they answered yes, they were asked to identify the type of activity in which they spent the most time. Answers to the open-ended questions were coded for up to 56 specific activities. Duration, frequency, and distance (if appropriate) were ascertained. This information was used to create a leisure-time physical activity score[15]: (1) inactive (no activity); (2) irregularly active (duration of <20 minutes per session, or frequency of <3/week); (3) regular, not intense (duration of >20 minutes and frequency of ≥3/week, but either large-muscle groups were not used or 60% of maximum cardiorespiratory capacity was not attained); and (4) regular, intense (duration, frequency, and intensity requirements met).

Age, marital status, education, body mass index, race, smoking, alcohol intake, and cholesterol screening were examined as potential confounders because of their possible relationship to both leisure-time

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TABLE 1—Characteristics of the Study Population, by Sex, Behavioral Risk Factor Surveillance System, 1990

	Men (n = 12 677), %	Women (n = 16 995), %
Age, y		
18–24	11.1	9.7
25–34	25.3	23.5
35–44	23.9	21.6
45–54	13.7	13.0
55–64	11.4	12.0
65+	14.6	20.2
Race		
White	92.8	90.4
Black	7.2	9.6
Education		
Less than high school	14.2	15.6
High school graduate	33.1	36.4
Some college[a]	25.1	26.1
College graduate	27.6	21.9
Marital status		
Married	64.7	55.9
Not married	35.3	44.1
Cholesterol screening		
Never screened	37.7	33.2
Screened, normal cholesterol	47.4	49.7
Screened, high cholesterol	15.0	17.1
Smoking status		
Never smoker	43.8	57.3
Former smoker	29.8	19.1
1–9 cigarettes/day	3.1	4.0
≥ 10 cigarettes/day	23.3	19.6
Alcohol consumption		
None	40.5	58.7
< 1/2 drink/day	28.7	30.6
1/2 to < 2 drinks/day	23.0	9.1
≥ 2 drinks/day	7.8	1.6
Body mass index		
Underweight	6.2	8.3
Normal weight	71.0	69.7
Overweight	15.0	15.8
Very overweight	7.8	6.3
Leisure-time activity		
Inactive	27.4	29.6
Irregular	31.2	27.5
Regular, not intense	31.9	33.7
Regular and intense	9.6	9.1
Fat intake		
1st quartile	24.0	24.7
2nd quartile	25.5	25.1
3rd quartile	25.5	25.1
4th quartile	25.0	25.1

[a]Includes technical school.

TABLE 2—Sex-Specific Odds of Being Inactive Relative to Being Active in the Past Month, by Demographic and Health-Related Factors, Behavioral Risk Factor Surveillance System, 1990

	Men			Women		
	Inactive, %	Odds Ratio[a]	95% CI	Inactive, %	Odds Ratio[a]	95% CI
Age, y						
18–24	17.1	1.0	Reference	25.5	1.0	Reference
25–34	20.8	1.6	1.3, 1.8	23.7	1.0	0.9, 1.2
35–44	25.8	2.3	1.9, 2.8	26.1	1.3	1.1, 1.5
45–54	32.3	3.1	2.6, 3.8	29.3	1.3	1.1, 1.5
55–64	38.2	3.8	3.1, 4.6	31.3	1.4	1.2, 1.6
65+	36.9	3.4	2.8, 4.1	41.4	2.0	1.8, 2.4
Race						
White	27.0	1.0	Reference	28.5	1.0	Reference
Black	32.1	1.1	1.0, 1.3	40.2	1.5	1.4, 1.7
Education						
Less than high school	47.4	1.0	Reference	48.6	1.0	Reference
High school graduate	34.0	0.7	0.6, 0.8	33.4	0.7	0.6, 0.8
Some college[b]	21.0	0.4	0.4, 0.5	23.0	0.5	0.4, 0.5
College graduate	15.0	0.3	0.3, 0.4	17.8	0.4	0.4, 0.5
Marital status						
Married	28.5	1.0	Reference	27.3	1.0	Reference
Not married	25.5	1.0	0.9, 1.1	32.6	1.1	1.0, 1.2
Cholesterol screening						
Never screened	31.1	1.0	Reference	32.2	1.0	Reference
Screened, normal cholesterol	24.6	0.7	0.6, 0.7	27.1	0.8	0.7, 0.9
Screened, high cholesterol	26.9	0.7	0.6, 0.8	31.7	0.9	0.8, 1.0
Smoking						
Never smoker	22.7	1.0	Reference	28.7	1.0	Reference
Former smoker	26.5	0.9	0.8, 1.0	24.4	0.9	0.8, 1.0
1–9 cigarettes/day	29.1	1.2	0.9, 1.5	31.4	1.3	1.1, 1.5
≥ 10 cigarettes/day	37.3	1.5	1.3, 1.8	37.1	1.6	1.4, 1.7
Alcohol intake						
None	35.8	1.0	Reference	36.2	1.0	Reference
< 1/2 drink/day	20.8	0.6	0.6, 0.7	20.8	0.6	0.6, 0.7
1/2 to < 2 drinks/day	20.5	0.6	0.5, 0.7	18.2	0.5	0.4, 0.6
≥ 2 drinks/day	28.7	0.8	0.7, 0.9	22.0	0.5	0.4, 0.7
Body mass index						
Underweight	33.3	1.4	1.2, 1.6	30.8	1.2	1.1, 1.4
Normal weight	24.7	1.0	Reference	26.8	1.0	Reference
Overweight	32.1	1.3	1.2, 1.5	35.0	1.2	1.1, 1.3
Very overweight	38.2	1.6	1.4, 1.9	46.0	1.8	1.6, 2.1

Note. CI = confidence interval.
[a]Adjusted for age, race, education, marital status, body mass index, cholesterol screening, smoking status, alcohol intake, and fat intake.
[b]Includes technical school.

physical activity and dietary fat. A body mass index (weight [kg]/height [m^2]), from self-reported height and weight was coded as underweight, normal weight, overweight, or very overweight with cutpoints of 20.7, 27.8, and 31.1 for men and 19.1, 27.3, and 32.3 for women.[16]

We used general linear model analysis of variance[17,18] to compute the sex-specific daily geometric mean fat score for respondents in different categories defined by demographic and health-related risk factors. Because of the skewed distribution, we used a natural log transformation after adding 0.5 to zero values. We used binary[19] and polychotomous[20] logistic regression to compute the sex-specific prevalence odds ratio of being in the highest (compared with the other three) sex-specific quartile of fat, and to compute the prevalence odds ratio of being inactive (compared with other levels of physical activity). All analyses were adjusted for the potential confounders listed above, and the goodness of fit of both models was assessed.[21,22] The effects of sample weights

TABLE 3—Sex-Specific Geometric Mean Fat Intakes and Odds of Being in the Top Quartile of Fat Intake Score Relative to Being in the Other Quartiles, By Demographic and Health-Related Factors, Behavioral Risk Factor Surveillance System, 1990

	Men				Women			
	Geometric Mean[a]	% in the Top Quartile	Odds Ratio[a]	95% CI	Geometric Mean[a]	% in the Top Quartile	Odds Ratio[a]	95% CI
Age, y								
18–24	43.9	44.9	1.0	Reference	34.0	41.5	1.0	Reference
25–34	38.3	31.8	0.7	0.6, 0.8	31.4	33.7	0.8	0.7, 0.9
35–44	34.7	23.7	0.5	0.4, 0.5	28.2	24.1	0.5	0.4, 0.6
45–54	31.1	18.2	0.3	0.3, 0.4	26.0	21.2	0.4	0.3, 0.5
55–64	29.1	15.3	0.2	0.2, 0.3	23.5	16.6	0.3	0.3, 0.4
65+	28.6	14.5	0.2	0.2, 0.3	23.7	16.0	0.3	0.3, 0.3
Race								
White	35.8	25.0	1.0	Reference	28.0	24.6	1.0	Reference
Black	32.1	25.4	0.8	0.7, 0.9	27.1	30.1	1.1	0.9, 1.2
Education								
Less than high school	36.8	29.6	1.0	Reference	29.0	27.2	1.0	Reference
High school graduate	35.4	30.6	0.8	0.7, 0.9	36.9	28.2	0.8	0.8, 0.9
Some college[b]	33.4	25.6	0.6	0.5, 0.7	27.6	25.8	0.7	0.7, 0.8
College graduate	30.4	15.5	0.4	0.4, 0.5	24.9	17.8	0.5	0.4, 0.6
Marital status								
Married	34.5	22.4	1.0	Reference	28.9	26.3	1.0	Reference
Unmarried	33.3	29.9	1.1	1.0, 1.2	26.2	23.7	0.8	0.8, 0.9
Cholesterol screening								
Never screened	38.8	35.1	1.0	Reference	30.8	34.3	1.0	Reference
Screened, normal cholesterol	34.2	21.1	0.8	0.7, 0.8	28.0	22.5	0.8	0.7, 0.8
Screened, high cholesterol	29.4	12.4	0.5	0.4, 0.5	24.2	14.8	0.5	0.5, 0.6
Smoking								
Never smoker	32.0	23.4	1.0	Reference	27.0	23.4	1.0	Reference
Former smoker	32.5	18.9	1.0	0.9, 1.2	26.3	19.9	0.9	0.8, 1.0
1–9 cigarettes/day	33.8	29.1	1.3	1.0, 1.6	27.0	29.7	1.2	1.0, 1.5
≥10 cigarettes/day	37.4	35.5	1.6	1.4, 1.8	30.1	34.3	1.5	1.3, 1.6
Alcohol intake								
None	32.6	24.4	1.0	Reference	26.8	25.2	1.0	Reference
<1/2 drink/day	33.1	23.4	1.0	0.9, 1.1	27.2	24.8	0.9	0.8, 1.0
1/2 to 2 drinks/day	34.2	25.5	0.9	0.8, 1.0	27.6	25.2	0.9	0.8, 1.1
≥2 drinks/day	35.8	33.0	1.2	1.0, 1.4	28.6	26.5	1.1	0.8, 1.4
Body mass index								
Underweight	34.7	35.3	1.2	1.0, 1.4	28.6	35.3	1.5	1.3, 1.6
Normal weight	33.1	24.6	1.0	Reference	26.5	24.2	1.0	Reference
Overweight	33.2	22.3	0.9	0.8, 1.1	27.5	24.2	1.1	1.0, 1.2
Very overweight	34.5	26.4	1.1	0.9, 1.3	27.5	24.4	1.0	0.9, 1.2
Leisure-time activity								
Inactive	37.1	29.4	1.0	Reference	30.3	29.9	1.0	Reference
Irregular	35.0	25.3	0.8	0.7, 0.9	29.1	26.1	0.8	0.8, 0.9
Regular, not intense	33.6	23.9	0.8	0.7, 0.8	26.5	22.6	0.7	0.6, 0.7
Regular and intense	30.2	15.3	0.6	0.5, 0.7	24.6	16.2	0.6	0.5, 0.7

[a]Adjusted for age, race, education, marital status, body mass index, cholesterol screening status, smoking, drinking, and physical activity.
[b]Includes technical school.

and clustering were not incorporated in the analysis, but the models included variables related to sampling design including age, sex, race, and education.[23]

Results

The study population was largely female and White (Table 1). Most were not sedentary, had been screened for cholesterol, and were nonsmokers.

Physical inactivity increased with age and smoking, decreased with education and alcohol consumption, and was somewhat more common among Blacks, those never screened for cholesterol, and those who did not have normal weight (Table 2).

A higher fat intake was associated with being younger, less well educated, not having cholesterol screening, and smoking (Table 3). Fat consumption decreased markedly with physical activity. The relationship between dietary fat and leisure-time physical activity was linear ($P < .0001$), and the odds ratio of being in the highest fat quartile was 0.6 for both men and women who were physically active compared with inactive.

Discussion

Our findings of associations between both physical activity and dietary fat and other factors are similar to those reported elsewhere.[24–30] Among Behavioral Risk Factor Surveillance System participants, lower fat consumption was associated with increased leisure-time physical activity. This association was strong and independent of the effects of other demographic and behavioral risk factors. Higher caloric intake, particularly ingestion of carbohydrates, has been observed with higher physical activity.[7,9,10] However, lower fat intake with higher physical activity has not been previously reported.[31] People who exercise need more calories than do those who are sedentary.[6,7,9,10] Hence, given these study findings, the percentage of calories from fat intake is likely to be substantially lower among people who are more physically active.

This study has several limitations. Because both fat consumption and being sedentary are socially undesirable, respondents may both overreport physical activity and underreport fat intake. However, social desirability is unlikely to produce an effect of this magnitude, and indirectly adjusting for social desirability by adjusting for alcohol consumption, body weight, smoking, and cholesterol screening did not substantially reduce the association.

Another limitation derives from the use of a 13-item fat score. However, Pearson correlations between the Behavioral Risk Factor Surveillance System fat score and dietary fat intakes measured by multiple food records or recalls ranged from 0.38 to 0.59, similar in magnitude to those obtained by more extensive food-frequency questionnaires (R. Coates, Emory University, unpublished manuscript).[32–34] We did not ask questions about portion size because such questions may not contribute substantially to dietary assessment.[35–37] Though we were unable to adjust for caloric intake, the relationship we observed between dietary fat and physical activity may underestimate the true association because caloric intake is positively associated with both dietary fat and physical activity.[7,38] Another limitation is that we examined only leisure-time physical activity. However, it is unlikely that occupational physical activity would contribute much because the proportion of American men in the highest-energy job category fell from 40% to 5% by the late 1970s.[39] The Behavioral Risk Factor Surveillance System underrepresents low-income groups without a telephone.[11] In addition, 16.7% of the respondents were excluded due to missing information. However, we adjusted for many demographics and health behaviors that could act as confounders related to these sampling issues.

The relationship between leisure-time physical activity and fat intake might be the result of clustering of healthy behaviors.[40] Because people who take up one health behavior may be inclined to take up others as well,[41] effects of one factor on health may be confounded by the related health behaviors.[42,43] These findings have two important implications. Etiologic studies should assess both physical activity and diet to examine individual and joint health effects, and creators of public health messages that target one of these behaviors should consider the benefit of targeting both. □

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Serial Mass-Media Campaigns to Promote Physical Activity: Reinforcing or Redundant?

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ABSTRACT

Changes associated with two serial, nationwide, mass-media-based campaigns to promote physical activity conducted by the National Heart Foundation of Australia in 1990 and 1991 were examined. Surveys conducted before and after each campaign found statistically significant differences in message awareness (46% vs 71% in 1990; 63% vs 74% in 1991). In 1990, there were significant increases in walking, particularly among older people, and in intentions to exercise. No such changes were apparent in 1991. In the case of these two campaigns, conducted 1 year apart, the second may have been redundant. (*Am J Public Health.* 1995;85:244–248)

Introduction

Habitual physical activity has cardiovascular and other health benefits,[1,2] but up to one third of the adult populations of industrialized countries engage in virtually no leisure-time physical activity.[3,4] Few populationwide attempts at exercise promotion have been systematically evaluated: studies have usually focused on volunteer populations or have targeted groups in specific settings.[5] The evaluations of such campaigns have shown increases in awareness of the benefits of physical activity, but limited data are available on behavioral change.[6–8] An earlier Australian study found increases in the prevalence of reported walking for exercise after a mass-media campaign in 1990; changes were most marked in older people and occurred across all socioeconomic groups.[9]

We examined the possible cumulative effect of serial campaigns to promote physical activity by using comparable data from the evaluations of two national campaigns conducted in 1990 and 1991. The campaign goals examined were (1) to increase recall of the campaign message; (2) to increase the proportion of the

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