

Applied nutritional investigation

How does a suicide attempter eat differently from others? Comparison of macronutrient intakes

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Manuscript received June 9, 2004; accepted November 25, 2004.

Abstract

Objective: Issues of the subtle effects of diet and nutrition on suicidal behaviors are rarely examined. This study describes the differences in dietary intakes of macronutrients between individuals who had ever made a suicide attempt and those who never had.

Methods: We examined the data of 7631 non-institutionalized adults ages 17 to 39 y who completed a mental disorder diagnostic interview and a 24-h dietary recall as a part of the Third National Health and Nutrition Examination Survey, 1988 to 1994. Multivariable adjusted means of daily caloric intake and energy percentage from macronutrients were calculated for individuals who had a history of lifetime suicide attempt(s) ($n = 408$) and compared with those who did not.

Results: After adjustment for covariates, including socioeconomic indicators, health risk factors, and history of medical and psychiatric illnesses, we observed that the means of daily caloric intake, cholesterol, and energy percentages from carbohydrate, total fat, saturated fat, monounsaturated fat, and protein did not differ significantly between attempters and non-attempters. However, energy percentage from polyunsaturated fat was lower in attempters than in non-attempters. Mean percentages \pm standard error for smoking attempters, non-smoking attempters, smoking non-attempters, and non-smoking non-attempters were 5.5 ± 0.4 ($P = 0.01$), 6.7 ± 0.2 ($P = 0.02$), 7.5 ± 1.4 ($P = 0.78$), and 7.2 ± 0.1 (reference), respectively, in men, and 6.3 ± 0.4 ($P = 0.01$), 7.2 ± 0.2 ($P = 0.07$), 7.3 ± 1.0 ($P = 0.89$), and 7.5 ± 0.1 (reference), respectively, in women. Dietary fiber intake was also lower in attempters than in non-attempters. These differences were independent of daily caloric intake.

Conclusions: Individuals with a history of suicide attempt have low intakes of polyunsaturated fat and fiber. Potential deleterious effects of low intake of polyunsaturated fat and fiber among suicide attempters merit further investigation. © 2005 Elsevier Inc. All rights reserved.

Keywords:

Attempted suicide; Macronutrients; Dietary intake; Unsaturated fatty acids

Introduction

Suicide is the third leading cause of death among young adults ages 15 to 34 y [1]. Suicide has been identified as one of the major public health concerns in the United States today [2]. The excessive mortality after suicide attempts, the precursor of suicide, has also emerged from many follow-up studies [3–8]. An attempted suicide implies a higher risk than having a men-

tal disorder such as major depression, personality disorder, or dependence on alcohol [9]. The rate of completed suicide is 100 times higher in attempters than that in the general population [10]. Unfortunately, effective intervention to prevent the repetition of suicide attempts or other deliberate methods of self-harm and occurrence of completed suicide among suicide attempters remains remote.

The cause, prevention, and therapy of suicidal behaviors are commonly reviewed from pharmacologic and social perspectives, but issues of the subtle effects of diet and nutrition are rarely examined. There has been a growing body of literature from observational studies and

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clinical trials documenting a relation between nutrition and emotional health. Recently, it was hypothesized that decreased consumption of polyunsaturated fatty acids (PUFAs), especially ω -3 fatty acids, may be a risk factor for depression and suicide [11]. Depressive symptoms may exist persistently after suicide attempt, and attempters may have less appetite, which in turn results in lower intakes of certain nutrients and, hence, further intensifies vulnerability to depression or other mental disorders. Promotion of healthy diet or eating behaviors might be a promising component for suicide management and prevention. Due to the difficulties of accurately measuring dietary intake and suicidality, the data on dietary patterns of individuals with a history of attempted suicide are sparse. Description of the differences in dietary pattern between suicide attempters and others has implications for the management of suicide patients and for the development of nutrient intervention.

We hypothesized that individuals with a history of attempted suicide would have low intakes of certain macronutrients, in particular polyunsaturated fat (PUF). Using a large population-based national sample of young adults, the aim of this study was to describe differences in dietary intakes of macronutrients between individuals who ever made a suicide attempt and those who never did.

Materials and methods

Study population

Data were obtained from the Third National Health and Nutrition Examination Survey (NHANES III), a cross-sectional survey of the U.S. non-institutionalized civilian population. The survey was conducted from 1988 to 1994. Detailed descriptions of the survey have been published elsewhere [12]. The sample of the current study consists of 8248 adults ages 17 to 39 y at interview, with information on dietary recall and mental health. We excluded 307 individuals whose daily intakes were extreme (total energy <500 or \geq 5000 kcal/d) and 310 pregnant women; thus, 7631 subjects remained for analyses.

Measurements and variable definitions

Attempted suicide

The mental health and neurobehavioral function component of NHANES III included depression and mania subsections, which had the question, “Have you ever attempted suicide?” The time frame for this question was lifetime. We classified participants into two groups, attempters and non-attempters, according to their answers to this question.

Dietary intake

A 24-h dietary recall was collected by a trained dietary interviewer in a Mobile Examination Center through an

automated interview using the Dietary Data Collection system. The Dietary Data Collection system was specifically designed to probe for fat and salt used in the preparation of foods. The types and amounts of foods consumed were recalled by using recall aids such as special charts, measuring cups, and rulers to help in quantifying the amounts consumed. Special probes were used to help the recall of commonly forgotten item such as condiments, accompaniments, fast foods, alcoholic beverages, etc. Participants were asked to report all foods and beverages consumed during the previous 24 h, from midnight to midnight. The food database for this system was linked to the U.S. Department of Agriculture’s Survey Nutrition Database and produced total energy intake [13].

Non-dietary variables

Socioeconomic social support indicators

Ethnicity was coded as non-Hispanic whites, non-Hispanic blacks, or others. Fewer than 13 y of education was grouped as below or at high school level; more years was classified as higher. Marital status was collapsed into two categories: single (included widowed, divorced, separated, or never married and individuals who were married but their spouses were not living in the household) versus cohabiting (including individuals married to their spouses who were living in the household). Total family income for the previous 12 mo was reported for categories ranging from less than \$1000 to at least \$80 000, in \$1000 increments below \$19 999 and in \$5000 increments from \$20 000 to \$79 999. A poverty index ratio was then calculated by comparing the midpoint for the category and the family size with the federal poverty line (poverty index ratio = 1). These analyses used three income categories: low income (poverty index ratio \leq 1.30, the federal cutpoint for eligibility for the Food Stamp Program), middle income ($1.30 <$ poverty index ratio \leq 3.00), and high income.

Health risk factors

Current cigarette smokers were defined as those who had smoked cigarettes in the past 5 d. Current alcohol drinkers were defined as those who had consumed at least 12 drinks in the past 12 mo. Leisure-time physical activity was measured by the frequency of exercise, sports, or physically active hobbies in the past month, such as jogging, running, riding a bicycle or an exercise bicycle, swimming, aerobics, aerobic dancing, calisthenics, lifting weights, or garden/yard activity. Participants who reported no leisure-time physical activities were classified as physically inactive. Those who checked fewer than three activities listed above were classified as irregularly active and those with three or more as regularly active. Self-evaluated health was determined by asking the participants, “Would you say your health in general is excellent, very good, good, fair, or poor?” Body mass index was used as the body image indicator.

Lifetime history of medical and psychiatric illnesses

In the NHANES III interview, the participants were asked, “Have you ever been told by a doctor that you had one or more of the following general medical illnesses: asthma, arthritis, cancer, chronic bronchitis, diabetes, hypertension, gout, lupus, stroke, or thyroid disease?” Because most of these illnesses are relatively rare in young adults and have a very weak association with attempted suicide in the general population [14], having a history of cancer (including skin cancer), asthma, or chronic bronchitis was coded as “yes” and having other illnesses or no illness was coded as “no.”

Statistical analysis

SUDAAN (SAS callable 7.5, Research Triangle Park, NC, USA) [15] with appropriate weighting and nesting variables [16] was used. Because the extremes have been excluded and the data of dietary intake were not significantly skewed, no data transformation was performed. Macronutrient intakes were expressed as percentages of energy, with cholesterol and fiber as exceptions. The main results were presented as least square (LS) means with standard errors. Covariates adjusted for LS means included total dietary energy intake and significant non-dietary variables. Depression is a well-established risk factor for suicidal behaviors, which may be in the pathway of the association between lower dietary intake and suicide attempts. To avoid overadjusting, diagnosis of major depressive disorder was not included in the multivariable models. Because gender has been well documented to be associated with suicidal and eating behaviors [17,18], the results were presented for men and women separately. The preliminary analyses indicated that smoking was a significant effect modifier of the association between dietary intake and suicide attempts. To adjust the effect modification of smoking, we further classified the study subjects into four groups: smoking attempters, non-smoking attempters, smoking non-attempters, and non-smoking non-attempters. Using non-smoking non-attempters as the referent group, we compared its LS means of macronutrient intakes with those of other groups. Due to the application of multiple comparisons, a Bonferroni adjustment of the α -level to $P < 0.013$ ($0.05/4$, two-side value) was considered statistically significant when comparing means between groups.

Results

Table 1 presents the selected characteristics of the weighted study population by gender. About $78.0 \pm 1.2\%$ of men and $78.2 \pm 1.3\%$ of women were non-Hispanic whites. Mean ages of the study population was 28.0 ± 1.4 y for men and 28.2 ± 1.3 y for women. There were significant differences between men and women in most characteristics selected. Compared with women, men were more likely not

to attend church, to be smokers at the time of interview, and to have a low prevalence of lifetime psychiatric or medical illnesses. The prevalence of a lifetime suicide attempt was two times as high in women as in men ($7.6 \pm 0.7\%$ versus $3.0 \pm 0.4\%$). Mean caloric intake was significantly higher in men than in women ($3,767 \pm 29$ kcal/d versus $1,940 \pm 22$ kcal/d). We observed that mean energy percentages from carbohydrate, monounsaturated fat, and PUF differed significantly between men and women. However, energy percentages from total fat, saturated fat and protein did not differ significantly between genders.

The multivariate adjusted means of macronutrients are presented by gender and smoking status (Table 2). In men, smoking status made more of a difference in total energy intake than did a history of suicide attempts. Regardless of the history of suicide attempts, the LS means of total calories of current smokers were less than those of non-smokers. Means of daily caloric intake were 2491 ± 163 kcal for smoking attempters and 2286 ± 464 kcal for smoking non-attempters, which differed from means of non-smokers, which were 2739 ± 46 kcal and 2917 ± 35 kcal, respectively. However, all these differences were not statistically significant. In women, regardless of smoking status and history of suicide attempts, means of daily total caloric intakes were approximately 1900 kcal for all four groups. For men and women, there were no statistical differences between the referent group and any other groups in terms of cholesterol intake and mean energy percentages from total fat, saturated fat, monounsaturated fat, carbohydrate, and protein. However, for both genders, we observed significant differences in total fiber intake and energy percentage from PUF between attempters and non-attempters within each gender. The lowest energy percentage from PUF was among smoking attempters for both sexes. The energy percentages from PUF for smoking attempters and the referent group were 5.5 ± 0.4 versus 7.2 ± 0.1 in men ($P = 0.004$) and 6.33 ± 0.4 versus 7.5 ± 0.1 in women ($P = 0.0109$), respectively. No significant differences were observed between the referent group and the other groups among men or among women. Regardless of smoking status, reported daily dietary fiber intake was significantly lower in attempters than in non-attempters. In women, mean daily intakes were 11.34 ± 3.9 g for smoking attempters and 12.8 ± 0.3 g for non-smoking attempters, whereas the reported dietary intake of referent group was 14.41 ± 0.22 g. In men, the lowest fiber intake was reported from smoking attempters. Due to a relatively large standard error, however, mean fiber intake among smoking attempters (15.8 ± 2.3 g) did not differ significantly from that of the referent group (20.0 ± 0.4 g). Instead, non-smoking attempters had a significantly lower fiber intake (16.8 ± 0.4 g) compared with the referent group.

We also recalculated the LS means of PUF by including fiber as an additional covariate, and the results remained unchanged. The same observation was obtained by control-

Table 1

Characteristics of weighted study population* ages 17 to 39 y, NHANES III, 1988 to 1994

| Characteristic | Men (n = 3533) | | Women (n = 4098) | |
|--|----------------|---------------|-------------------------|----------------------------|
| | % (SE) | Mean (SE) | % (SE) | Mean (SE) |
| SES and social support indicator | | | | |
| Ethnicity: white, non-Hispanic | 78.0 (1.2) | | 78.2 (1.3) | |
| Age (y) | | 28.0 (0.2) | | 28.2 (0.3) |
| Education: high school or lower | 24.2 (1.4) | | 20.8 (1.3) [†] | |
| Family income: <130% of poverty line | 18.9 (1.3) | | 24.2 (1.5) [‡] | |
| Marital status: single | 46.4 (1.7) | | 46.5 (1.4) | |
| Church attending: never | 49.6 (1.6) | | 39.7 (1.5) [‡] | |
| Health risk factor | | | | |
| Current smoker: yes | 38.5 (1.6) | | 33.5 (1.3) [‡] | |
| Alcohol drinker: yes | 30.1 (1.4) | | 19.5 (1.3) [‡] | |
| Physical activity: inactive | 19.5 (1.2) | | 26.6 (1.1) [‡] | |
| Body mass index (kg/m ²) | | 25.3 (0.1) | | 25.1 (0.2) |
| History of medical and psychiatric illnesses | | | | |
| Cancer/pulmonary disease: yes | 8.3 (0.7) | | 14.7 (0.8) [‡] | |
| Depression: yes | 5.3 (0.6) | | 11.8 (0.9) [‡] | |
| Life-time attempted suicide: yes | 3.0 (0.4) | | 7.6 (0.7) [‡] | |
| Dietary intake | | | | |
| Total energy intake (kcal/d) | | 2767.6 (29.0) | | 1939.5 (21.8) [‡] |
| %Energy intake from [§] | | | | |
| Carbohydrate | | 48.9 (0.4) | | 51.0 (0.4) [‡] |
| Protein | | 15.0 (0.2) | | 14.5 (0.2) |
| Total fat | | 34.0 (0.3) | | 33.6 (0.3) |
| Saturated fat | | 11.6 (0.1) | | 11.4 (0.1) |
| Monounsaturated fat | | 12.9 (0.1) | | 12.4 (0.1) [‡] |
| Polyunsaturated fat | | 6.9 (0.1) | | 7.3 (0.1) [‡] |
| Cholesterol (mg/1000 kcal/d) | | 120.4 (2.8) | | 123.1 (2.8) |

NHANES III, Third National Health and Nutrition Examination Survey; SE, standard error; SES, socioeconomic status.

* $P < 0.01$.† $P < 0.05$.

‡ Total weighted population: 40 005 033 men and 41 450 930 women.

§ Percentages of kilocalories from different macronutrients were calculated as: %energy = ([total intake of macronutrient (grams) × converting factor]/total energy intake) × 100. The converting factors are 4 kcal/g for carbohydrate and protein and 9 kcal/g for total and subtype fat.

ling for PUF when recalculating the LS means of fiber intake.

Discussion

By using unique data from a national survey, the present study was able to describe dietary macronutrient intakes of individuals who had made a suicide attempt during their lifetime and compare those intakes with those of individuals who had never attempted suicide. After controlling for alcohol consumption, family income, education, marital status, history of psychiatric and medical illness, leisure-time physical activity, and self-evaluated health, we observed that, in contrast to an anticipation, daily caloric intakes between attempters and non-attempters were not statistically different; instead, it was the energy percentage from PUF and fiber intakes that were significantly lower among attempters, particularly smoking attempters, compared with non-smoking non-attempters.

It should be noted that, with a cross-sectional design, the present study could not determinate whether suicide

attempts preceded or followed from low intake of PUF or fiber. However, it was likely that changes in diet occurred after suicide attempts. A previous suicide attempt is significantly associated with post-traumatic stress disorder symptomatology [19]. Conceivably, post-traumatic stress disorder may result in less appetite, skipping meals, and less energy intake. However, our results did not support this assertion; instead, we found that dietary change may selectively affect energy percentage from PUF and intake of fiber but leave total energy intake and percentages of total fat, saturated fat, monounsaturated fat, carbohydrate, and protein unaffected. Over the past 20 y, the beneficial effects of PUFAs have been demonstrated in the prevention and management of coronary heart disease, hypertension, diabetes, renal disease, and chronic obstructive pulmonary disease [20]. High intake of fiber has long been demonstrated to be a protective factor against many health problems, such as heart disease, colon cancer, and diabetes. Low intake of PUF and fiber may contribute to the increased mortality of natural causes among individuals with a history of suicide attempts observed by many investigators [3–8].

Table 2
Adjusted* means (standard errors) of dietary intake in adults ages 17 to 39 y: NHANES III, 1988 to 1994

| Dietary intake | Men (<i>n</i> = 3533) | | | Women (<i>n</i> = 4098) | | |
|------------------------|------------------------|--------------------------|--------------------------|---|--------------------------|---|
| | Smoking attempter | Non-smoking attempter | Smoking non-attempter | Non-smoking non-attempter [§] | Smoking non-attempter | Non-smoking non-attempter [§] |
| Unweighted sample | 61 | 36 | 1175 | 139 | 172 | 2,854 |
| Total energy (kcal) | 2490.7 (163.3) | 2738.5 (46.3) | 2286.0 (464.2) | 1869.2 (103.9) | 1974.8 (43.3) | 1940.3 (27.4) |
| Total cholesterol (mg) | 381.8 (45.9) | 366.6 (13.8) | 299.0 (57.2) | 207.2 (17.5) | 245.5 (11.1) | 243.3 (5.9) |
| % Energy from | | | | | | |
| Carbohydrate | 48.6 (1.7) | 48.3 (0.6) | 47.6 (2.1) | 48.9 (0.5) | 50.3 (0.6) | 50.5 (0.4) |
| Protein | 14.0 (0.7) | 14.7 (0.3) | 16.9 (1.3) | 15.3 (0.2) | 14.4 (0.3) | 14.9 (0.2) |
| Total fat | 33.9 (1.4) | 33.8 (0.5) | 33.9 (2.1) | 34.2 (0.3) | 33.9 (0.5) | 33.6 (0.3) |
| Saturated fat | 12.3 (0.9) | 11.7 (0.3) | 10.8 (0.7) | 11.4 (0.2) | 11.5 (0.3) | 11.3 (0.2) |
| Monounsaturated fat | 12.7 (0.7) | 12.9 (0.2) | 12.9 (0.7) | 13.0 (0.2) | 12.7 (0.2) | 12.4 (0.1) |
| Polyunsaturated fat | 5.5 (0.4)* | 6.7 (0.2)* | 7.5 (1.4) | 7.2 (0.1) | 7.2 (0.2) | 7.5 (0.1) |
| Fiber (g) | 15.8 (2.3) | 16.8 (0.4)* | 18.5 (2.2) | 11.3 (0.9)* | 12.8 (0.3)* | 14.4 (0.2) |

NHANES III, Third National Health and Nutrition Examination Survey.

* $P < 0.05$.† $P < 0.013$ (0.05/4, Bonferroni adjusted test).

‡ Adjusted for age (continuous), total daily caloric intake, years of education attainment, current alcohol drinker (yes/no), self-evaluated health status, income (three categories), marital status (single/cohabiting), body mass index (continuous), medical and psychiatric illness (yes/no), and leisure-time physical activity (inactive, irregular, and regular). Analyses were conducted separately for men and women.

§ Referent group for each gender; pairwise comparisons were made between the referent group and other groups within the same gender.

Follow-up studies have shown that significant excess mortality among individuals with a history of attempted suicide is attributable to repetition of medically serious suicide attempts and death by completed suicides [21]. One possible explanation for this persistency is that individuals with a history of suicide attempt are more impulsive or genetically predisposed for deliberately self-harm behaviors [9]. Another alternative, suggested by the results of the present study, might be associated with low intake of PUF. The brain is entirely dependent on dietary sources for essential PUFAs and selectively concentrates docosahexaenoic acid into synaptic neuronal membranes. Low intake of PUFAs may alter concentrations of highly unsaturated fatty acids in neuronal tissues [22,23]. Decreasing unsaturated fatty acids from neuronal membranes may have important biophysical consequences in modulating serotonergic neurotransmission. A more recent human study has, for example, found that PUFAs, in particular ω -3 essential fatty acids, predict levels of metabolites of serotonin and dopamine taken from cerebrospinal fluid [23], and improvements in behavior could be achieved by providing a formulation with proportionally more ω -3 fatty acids to college students under mental stress [24] and young adult prisoners with antisocial behavior [25]. PUFAs have also been reported to be effective in the management of various psychiatric disorders, such as major depressive disorder [26], schizophrenia [27], and bipolar disorder [28].

To date, multiple mechanisms between PUF and mental disorders have been proposed, e.g., their effects on the structural integrity and fluidity of membranes and their role as precursors for eicosanoids [29]. However, there is no biological plausibility to explain the difference in dietary fiber between attempters and non-attempters that we observed. We do not think there is any contributory or causal effect of low dietary fiber intake on the development of suicide behaviors; rather, we believe that reverse causation is likely. It is not uncommon for depressed individuals, such as individuals with a recent history of attempted suicide, to skip meals and/or eat unhealthy food to cope with anxiety or post-trauma depression, and low fiber generally is one feature of unhealthy food.

The interaction between smoking and dietary intakes was evident in the present study. For both sexes, the lowest intakes of PUF and fiber occurred in smoking attempters. It has long been documented that smoking contributes to an increase in mortality from various diseases. Low PUFA intake may further intensify the deleterious effects of smoking and depression on cell membrane function and immune system and, hence, result in an increased mortality of smoking attempters from natural and non-natural causes.

The major limitations of the present study were related to the cross-sectional design. Low intake of PUFA and attempted suicide are potentially influenced by undefined factor(s), including by genetic factor(s) by development of food preferences [30]; therefore, the observed covariation between intake of PUFA and attempted suicide could

have been due to concurrence or the concomitant expression of genotype without PUF and attempted suicide being causally related to one another. As in all research using self-reported measurements, the response from interviewees may represent the perceptions of the respondents because of social desirability, and under-reporting might be a concern for suicide attempts [31] and dietary intake [32–34]. A single assessment of dietary intake may not precisely reflect a subject's long-term intake [32], which might be more relevant. However, it also must be noted that data from a single 24-h recall interview are associated with only slightly higher variances than those associated with food frequency questionnaires and works relatively better for macronutrients than for micronutrients [35–37]. The ability to detect a significant difference was constrained by not sampling the individuals who may have been institutionalized due to severe medical consequences of suicide attempts or the individuals who completed suicides. These individuals are more likely to differ further from the non-attempters. Exclusion of the extremes for normality improvement of data distribution may have further scarified the statistical power. In addition, dietary intake of subtype PUFAs, such as fish ω -3 fatty acids, eicosapentaenoic acids, docosahexaenoic acid or the ratio of these subtypes might be more relevant to mental status and behaviors [11,29,38–40]. Unfortunately, NHANES III did not collect data on subtypes, leaving the conclusion of the present study less specific. The present study also has strengths. To the best of our knowledge, this study is the first to describe dietary differences in macronutrients between attempters and non-attempters. The participants of NHANES III were randomly selected from the community-dwelling population; therefore, our results should be generalizable to adults in the United States.

The present study, coupled with evidence from a limited number of clinical trials, suggests a need to improve dietary education and provide more nourishing diets to individuals with high suicidality. If it is confirmed from large-scale clinical trials that specific dietary fats can play a contributory role, therapeutic role, or both in the care of suicidal attempters, promotion of a healthy lifestyle, including smoking cessation and dietary modification, may decrease the risk for natural diseases and repetition of suicidal behavior.

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