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Fish consumption and severely depressed mood, findings from the first national nutrition follow-up study

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ABSTRACT

The evidence obtained from prospective studies to support the hypothesis that fish consumption may improve mental status remains limited. The current study prospectively assessed a low frequency of fish consumption as a risk factor for depressed mood. Included were 5068 adults aged 25–74 years examined in 1971–1975 as the baseline of the First National Health and Nutrition Examination Survey Follow-up Study. Frequency of eating fish at baseline was obtained using a 3-month food frequency questionnaire. Severely depressed mood (SDM) was defined as the Center for Epidemiologic Studies Depression Scale scores ≥22 or taking anti-depressants. After an average of 10.6 years of follow-up, among men ($n=2039$), the percentage of individuals with SDM was 11.7%. Compared with frequent consumers (more than once a week), the odds ratios (ORs) were 1.43 (95%CI = 0.66–3.11) and 2.08 (1.08–4.09) respectively for the men eating fish once a week and less than once a week (p for trend = 0.03). Among women ($n=3029$), the percentage of individuals with SDM was 17.89%. The ORs were 1 (reference), 0.91 (0.68–1.22) and 1.15 (0.83–1.59) respectively for the women eating fish more than once, once, and less than once a week. These estimates were obtained after adjustment for indicators of social deprivation and major physical diseases. The study concluded that independently from social deprivation and physical diseases, low fish consumption was a risk factor for SDM among men. Further studies are needed to confirm these findings and elucidate mechanisms for the difference between men and women.

1. Introduction

In spite of the on-going controversy over the Food and Drug Administration's ruling that antidepressants will be labeled with a "black box" warning about the drugs' high potential suicide risk, the rule has fueled a searching for the natural antidepressant contained in dietary sources (Friedman and Leon, 2007; Antonuccio, 2008). There is converging evidence from ecological studies (Hibbeln, 1998; Hibbeln, 2002), cross-sectional analyses (Tanskanen et al., 2001; Zhang et al., 2005a; Raeder et al., 2007; Schins et al., 2007; Sontrop et al., 2008; Murakami, et al., 2010; Riemer et al., 2010), case control (De, Sr. et al., 2003; Sarri et al., 2008; Rees et al., 2009; Assies et al., 2010) and follow-up studies (Otto et al., 2003; Timonen et al., 2004; Sanchez-Villegas et al., 2007; Astorg et al., 2008; Akbaraly et al., 2009; Bountziouka et al., 2009; Colangelo et al., 2009; Golding et al., 2009), as well as randomized trials (Peet and Horrobin, 2002; Nemets et al., 2006; Su et al., 2008; Lesperance et al., 2010; Rondanelli et al., 2010), indicating that diets containing Ω-3 fatty acids, particularly fish and other seafood, may prevent depression and play a role in the prevention and treatment of mental disorder. The brain and central nervous system contain high concentrations of Ω-3 fatty acids, and a role of Ω-3 fatty acids in neurotransmitter synthesis, degradation, release, reuptake and binding has been demonstrated in biochemical studies (Levant et al., 2007; Su, 2009) and from animal models (Delion et al., 1996). Clinically, lower concentrations of Ω-3 fatty acids were observed in the plasma or red blood cell membranes of patients with psychological distress (Lucas et al., 2009a; Lucas et al., 2009b), and patients with a major depressive disorder (Edwards et al., 1998; Peet et al., 1998; Sarri et al., 2008; Gow et al., 2009) in comparison with controls, and depression severity has been found to correlate with the balance between Ω-3 and 18:3n-6 fatty acids in plasma (Tiemeier et al., 2003) and erythrocyte phospholipids (Maes et al., 1999) among patients. The magnetic resonance images revealed that, modest consumption of tuna/other fish, the prime source of Ω-3 fatty acids, was associated with greater gray matter volume (Conklin et al., 2007), and lower prevalence of subclinical infarcts and white matter

Abbreviations: CES-D, Center for Epidemiologic Studies Depression Scale; NHEFS, National Health and Nutrition Examination Survey I Epidemiology Follow-up Study; NHANES I, the first National Health and Nutrition Examination Survey; SDM, severely depressed mood.

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abnormalities among older adults (Virtanen et al., 2008). And most recently, using fluorodeoxyglucose positron emission tomography, a new modality of brain imaging, Sublette et al. observed that plasma levels of essential PUFA was correlated with regional human brain activity during a major depressive episode (Sublette et al., 2009). An autopsy study also demonstrated that docosahexaenoic acid (DHA) was the only fatty acid that was significantly different in the postmortem orbitofrontal cortex of patients with major depressive disorder relative to healthy controls (McNamara et al., 2007). The epidemiological evidence linking consumption of fish to depression, however, has not been consistent. Contrast to the studies reporting a significant association between depressive disorder and low Ω-3 fatty acids or infrequent fish consumption, a number of studies failed to observe this association(Hakkarainen et al., 2004; Miyake et al., 2006; Appleton et al., 2007a; Murakami et al., 2008; Strom et al., 2009; Suominen-Taipale et al., 2010; Poudel-Tandukar et al., 2011) or the therapeutic effectiveness of Ω-3 fatty acid supplements(Appleton et al., 2008; Freeman et al., 2008; Rees et al., 2008; Rogers et al., 2008; van de et al., 2008; Antypa et al., 2009; van de et al., 2009), leading researchers to suspect that the apparent associations observed mostly from ecological and cross-sectional studies may simply reflect an association between depressed mood and social deprivation and/or lifestyle (Appleton et al., 2007a; Appleton et al., 2007b; Strom et al., 2009; Suominen-Taipale et al., 2010; Poudel-Tandukar et al., 2011) or reverse causative effects of depressed mood (Freeman, 2010; Jacka et al., 2010). We took advantage of the prolonged follow-up experience of participants in the National Health and Nutrition Examination Survey I Epidemiology Follow-up Study (NHEFS) to prospectively assess the relationship of fish consumption to the subsequent development of depressed mood. The comprehensive baseline information in the NHEFS provides an opportunity to control for the confounding effects from social deprivation and lifestyle.

2. Subjects and methods

2.1. Study population

Detailed descriptions of the NHEFS have been published elsewhere (Madans et al., 1986a; Madans et al., 1986b; Ingram and Makuc, 1994; National Center for Health Statistics, 1997). In brief, the NHEFS was a study of adults aged 25–74 years who participated in the first National Health and Nutrition Examination Survey (NHANES I) from 1971 to 1975 ($n=14,407$). In the 1982–1984 follow-up survey, of the original NHANES I cohort, 15.1% were deceased, 7.1% were lost to follow-up, and 73% ($n=10,523$) of the participants were successfully traced and interviewed. The current study included the NHEFS participants who remained alive and had completed information on depressive symptoms assessed in 1982–1984 ($n=9517$). We excluded participants with 24-hour dietary recall coded as unsatisfactory ($n=70$), those with fish consumption missed from food frequency questionnaires ($n=2237$), those with information on alcohol drinking, cigarette smoking ($n=1779$) not available, and those with uncompleted data on socioeconomic status (SES), i.e. income level, education attainment, marital status, and type of residential area ($n=200$). An additional 163 participants were excluded due to an unavailability of body mass index (BMI), serum total cholesterol at the baseline, self-evaluated health status or the history of major physical diseases at the follow-up, leaving 5068 available for final analysis (Fig. 1).

2.2. Severely depressed mood (SDM)

Depressed mood was assessed in the 1982–1984 follow-up survey using the Center for Epidemiologic Studies Depression Scale (CES-D) questionnaire. The CES-D questionnaire was developed for epidemiologic surveys of the general population to measure depressive feelings and behaviors during the past week (Weissman et al., 1977). It consists of 20 descriptive statements of depressed mood, feelings of worthlessness, hopelessness, and loneliness; loss of appetite; sleep disturbances; concentration problems; and psychomotor retardation. Participants were asked to rate each item according to the frequency experienced in the past week and scored on a standard 4-point scale from 0 to 3. The 20 items had a potential range of 0–60, with the higher scores representing responses in the depressed range. Only persons who answered all 20 items on the questionnaire were included in the current analysis. Those with a total score on the CES-D ≥ 16, which corresponds approximately to the 80th percentile score, were considered to have severely or moderately depressed mood. A cut-off ≥ 22 has also been used as an indicator of severely depressed mood in previous studies (Husaini, 1980; Zhang et al., 2005b; Celentano et al., 2008). In the preliminary analyses, we observed that CES-D ≥ 16 as the cut-off was not able to identify distinct levels of severity of the symptoms and provide adequate statistical power to detect the association. We finally categorized participants as having SDM and not using the cutoff CES-D ≥ 22. The individuals who were taking anti-depression medication when the follow-up interview was conducted ($n=143$) were also included as having SDM. Sensitivity analysis using cutoff CES-D ≥ 16 was also performed.

2.3. Fish consumption

A 3-month food frequency questionnaire was administered at the baseline survey (1971–75) by trained interviewers, usually registered dietitians. The questionnaire covered the 3 months prior to the interview and referred to usual consumption excluding periods of illness or dieting. Information was collected on 18 groups ingested daily and/or weekly in the usual pattern accounting for all regular meals eaten as well as for between meal foods or snacks, Monday through Sunday, including holidays. The interviews were conducted in specially designed mobile examination units. On-site evaluations, review of questionnaires, and taped interviews were conducted as part of the data quality control, only dietary records coded as satisfactorily completed by interviewers were used in this analysis. The primary item used in this investigation asked participants "how often fish or shellfish was eaten in the past 3 months, excluding periods of illness or dieting?" The choices of the response available in the original questionnaire were, never, less than once a week, one to six times per week, one to two times per day, and unknown. Categories of fish consumption used in the current analysis were selected to identify distinct levels of consumption and to provide adequate numbers at risk in each level. Three categories of consumption frequency were analyzed: less than once a week (including never), once a week, and more than once a week.

2.4. Covariates

Covariates included socioeconomic status (SES) or social deprivation indicators, behavioral and dietary characteristics at the baseline, self-evaluated health status and the specific medical condition at the follow-up. Since more than 90% of the samples were whites, ethnicity was simply coded as whites and others. Education attainment at baseline was measured as the highest completed grade of school. Marital status was

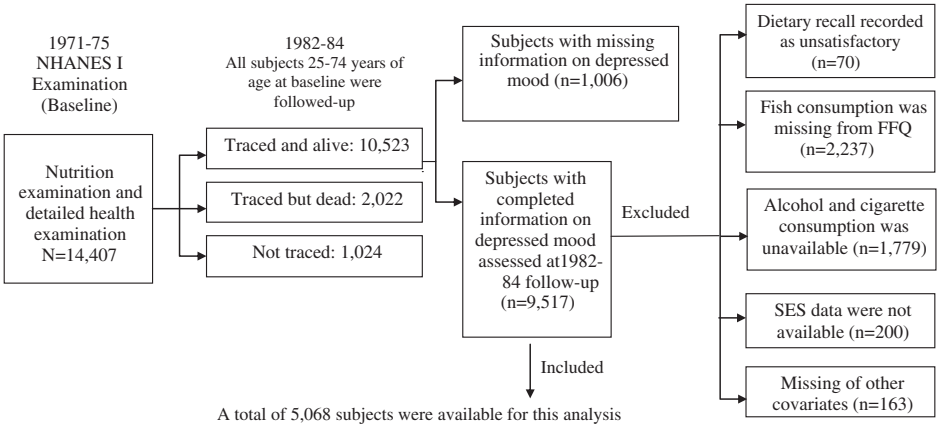

Fig. 1. Flow chart of the study population included.