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Seafood Consumption and Homicide Mortality

A Cross-National Ecological Analysis

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Deaths due to homicide have long been of interest to public health, in part due to their dramatic and tragic nature. Rates of death due to homicide show a more than 20-fold variation across countries in a similar pattern to cross-national differences in mortality from cardiovascular disease, which suggests that similar dietary factors may be important. This ecological relationship may be important because factors such as hostility, depression and anger increase risk of cardiovascular morbidity. A cross-national analysis previously described a robust protective relationship between seafood consumption and lower prevalence rates of major depression [1] indicating that ω3 fatty acid consumption may have psychotropic effects. Both observational and direct intervention studies have suggested that adequate tissue concentrations of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) may protect impulsive and violent behaviors as well as the closely related parameter of hostility. Virkkunen et al. [2] reported that impulsive and violent offenders had lower plasma concentrations of DHA and higher concentrations of 22:5 ω6 than nonimpulsive offenders and healthy controls. In a double-blind placebo-controlled intervention trial of 2 g of DHA/day, Hamazaki et al. [3] documented reductions in a measure of hostility among Japanese students under the stress of University exams. Weidner et al. [4] also noted a decrease in measures of hostility in a 5-year dietary intervention study that increased fish intake. It is reasonable to assume that measures of the affective state of hostility are in a continuum that includes violent behavior in the most extreme cases.

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Violent and impulsive behaviors, in particular suicide, have been repeatedly associated with low concentrations of a metabolite of serotonin, 5-hydroxyindolacetic acid assessed in cerebrospinal fluid (CSF 5-HIAA) [5]. These low CSF 5-HIAA concentrations are thought to reflect impaired frontal cortex function [5]. Linnoila et al. [6] found that low concentrations of CSF 5-HIAA distinguished impulsive violent offenders from violent offenders with premeditated intent. Among healthy volunteers, low concentrations of CSF 5-HIAA were correlated to low concentrations of plasma DHA [7]. This observation was consistent with the hypothesis that an insufficient status of tissue EPA and DHA may increase predisposition to impulsive behaviors [8]. Among recent suicide attempters, Hibbeln et al. [9] reported that low plasma concentrations of EPA robustly predicted increased severity of psychometric measures closely related to suicide; greater guilt, greater impulsivity, greater scores on the suicide assessment scale and greater severity on most subscales of the Comprehensive Psychopathological Rating Scale.

Two epidemiological studies within countries describe results that are consistent with these biochemical findings of low ω3 status being related to impulsive behaviors. Tanskanen et al. [10] examined 1,767 subjects in Northern Finland. They reported that frequent fish consumption (twice per week or more) significantly reduced the risk of reporting depressive symptoms (odds ratio = 0.63, $p < 0.03$) and of reporting suicidal thinking (odds ratio = 0.57, $p < 0.04$). In a study of 265,000 Japanese men followed for 17 years, Hirayama [11] found that daily fish consumption significantly reduced the risk of death due to suicide (odds ratio = 0.81) compared to eating fish less than every day.

Considering these epidemiological and biochemical data, this analysis tested the hypothesis that countries with higher per capita rates of seafood consumption will have lower rates of mortality due to homicide.

Methods

Rates of death due to homicide were published in the 1995 Annual Health Statistics report of the World Health Organization [12]. Data on apparent seafood consumption were published by the Food and Agriculture Organization of the WHO [13]. Apparent seafood consumption is defined as disappearance of seafood from the economy calculated as catch plus imports minus exports. The US was excluded from the initial analysis as the rate of death due to homicide was 20, more nearly double than that of any other country in the study and nearly 10-fold greater than the mean. Simple Pearson's product-moment correlations and logarithmic regressions were performed using Statview 5.0 (SAS Institute, Cary, N.C., USA).

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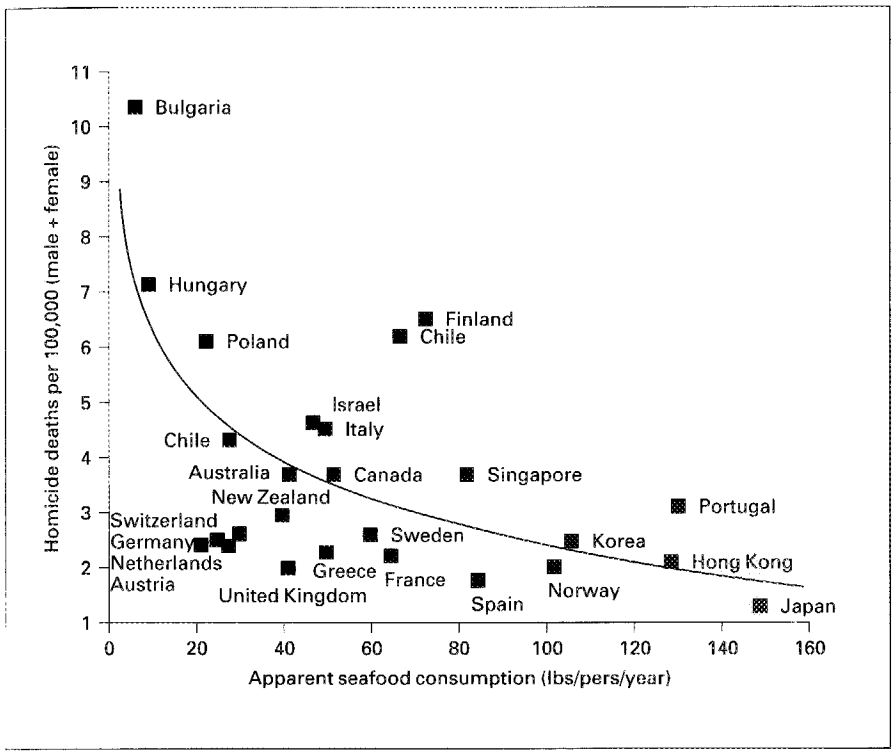

Fig. 1. This scattergram indicates the relationship between homicide mortality rates and seafood consumption across countries. Results of a logarithmic regression model including all countries are: $r = -0.63$, $p < 0.0006$, $n = 26$ countries. Results of a logarithmic regression model excluding Asian countries are: $r = -0.58$, $p < 0.006$, $n = 21$ countries.

Results

A nearly 10-fold difference in rates of homicide mortality was observed, excluding the US. In this analysis, Bulgaria had the highest rate of 10.3 per 100,000, and Japan had the lowest rate of 1.8 per 100,000. Finland and Chile did not appear to fit the regression curve well. The rates of homicide mortality in Chile were skewed towards males (5.4 per 100,000) in comparison to females (0.8 per 100,000). Countries with lower apparent seafood consumption had higher rates of death due to homicide in $r = -0.47$, $p < 0.01$ in a simple regression and $r = -0.63$, $p < 0.0006$ in a logarithmic regression model (fig. 1). Several non-Asian countries have both high rates of seafood consumption and low rates

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of death due to homicide. None the less, the analysis was repeated excluding all Asian countries due to the large potential confounds comparing Western and Asian countries. The results were not significantly different ($r = -0.58$, $p < 0.005$, logarithmic regression) compared to the model that included all countries.

Discussion

These results support the hypotheses that lower levels of seafood consumption, and presumably EPA and DHA intake, predict higher rates of death due to homicide. The data appear to indicate that an important threshold occurs between 20 and 40 lbs/person per year apparent seafood consumption. In this study, it was not possible to control for important confounding factors such as alcohol consumption, law enforcement or cigarette smoking. There are however several aspects that add confidence to the interpretation that seafood consumption is a mitigating factor in death rates due to homicide. First, the data describing both seafood consumption and the mortality due to homicide data each come from single source documents. Second, a death due to homicide is fairly easy to identify and count. Third, exclusion of Asian countries does not significantly alter the results. The rate of death due to homicide in the US was reported as 20.0/100,000, while the mean for all other countries was 4.3 (SD 3.7). Thus, the US was excluded a priori from the homicide analyses due to the extreme differences in availability of firearms and exposure to violence in the media. One interpretation of this large difference is that the availability of firearms or the exposure to violent media may have a more powerful effect on rates of homicide than the ω3 fatty acid status. Caution should be taken to not over interpret these data as describing a causal relationship between inadequate seafood consumption and homicide. There are many potentially confounding factors in this cross-national analysis, as there are many complex social and cultural factors that influence homicide rates. Hopefully these results will stimulate the design of stringently controlled double-blind placebo-controlled studies that can accurately determine if EPA and DHA can reduce violent and impulsive behaviors that may result in homicides.

Finally, it is reasonable to speculate that that if seafood has an important biological role in reducing impulsivity or violence, then the cultural symbolism of fish may have become associated with calming or peaceful behaviors over the millennia of human civilization. In Asian cultures, specifically Chinese, fish is perceived as being a Yin or calming food. In Western cultures, the fish is a core and ancient symbol of Christianity which is older than the crucifix. The identity is so close that the Greek word for fish, 'ΙΧΘΥΣ', is an anagram for the word Christ. Among the multiple references to fish in the bible, it was reported to be

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the first meal that Christ ate after his resurrection. The core sermon of Christianity, the sermon on the mound, describes a philosophy of nonimpulsive and calm behavior. Christians are literally instructed to turn the other cheek when assaulted, which would certainly reduce homicides. Closely associated with this sermon is the story of the miracle of the loaves and fishes. This symbolism is more than a dietary recommendation to consume more fish; it is nearly a dictum to encourage production and consumption. From 1542 until the 1960s, the Roman Catholic Church encouraged the consumption of fish and seafood on at least 1 day of the week, Friday or Wednesday or both, on all Christian feast days and throughout nearly all of the 40 days of lent. If fish were consumed on all of these days, then certainly an average of more than 3 fish meals per week would be consumed, a reasonable modern dietary recommendation. It is possible that one reason the symbolic association of fish and peaceful behaviors has persisted for more than 2,000 years in Western society is that consumption of the ω3 fatty acids in fish have the biological psychotropic effects of reducing impulsive and violent behaviors.

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