Dietary Tryptophan Ratio and Homicide in Western and Southern Europe

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Abstract

A study by Mawson and Jacobs was replicated by examining the possible relationship between diet and homicide in 18 western and southern European countries. For each country, the level of serotonin in brain neurons was inferred from the tryptophan ratio based on per capita supply of various foods. No correlation was found between low tryptophan ratios and high homicide rates. However, when the countries were matched on the basis of similarity and were tested again by the Wilcoxon matched-pairs signed-ranks test, a significant relationship was obtained. The results suggest both the social and cultural factor and the biochemical factor are important in influencing homicidal behaviour.

According to Mawson and Jacobs (1978), countries above the median in corn consumption have significantly higher homicide rates than countries below the median in corn consumption. The theoretical explanation for their finding is that the brain neurotransmitter serotonin, which inhibits aggression, is derived from its precursor tryptophan. Among various grains, corn contains low amounts of tryptophan as compared with other amino acids. Since the transport of tryptophan into the brain is regulated by a ratio of free plasma tryptophan to certain other amino acids (Fernstrom and Wurtman, 1972), in a country in which the people consume corn-based diet, less serotonin is likely to be formed in their brain neurons. For this reason, they are likely to show more aggressive behavior including homicide (Mawson and Jacobs, pp. 227-228, 1978). The purpose of this paper is to report the result of testing the same hypothesis by using different data and a different method of estimating the level of serotonin in brain neurons.

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Problem and Method

Although the result of the Mawson-Jacobs study offers us a very interesting avenue for further research, their finding suffers from two weaknesses. First, the method of considering only corn consumption is inadequate. If we wish to infer the level of serotonin in brain neurons on the basis of dietary habit, it is naturally necessary to take all foods into account. Second, Mawson and Jacobs do not include the factor of society and culture as a variable in explaining homicide, although they do emphasize it. It is quite conceivable that even when a person has a low level of serotonin in his brain neurons, he may be inhibited from committing homicide. A culture may encourage or discourage homicide when the level of serotonin is quite low. In this study, these two points are taken into account.

In order to estimate the level of serotonin in brain neurons from dietary habit among a given people, a publication by the Food and Agriculture Organization (FAO) of the United Nations (FAO, 1980) was used. This publication lists average per capita supply of various food items in 164 countries and territories from 1975 to 1977. From this publication, then, it was possible to estimate the amount of various foods consumed per capita. The average level of serotonin in brain neurons in a given country

was inferred by calculating the amount of tryptophan contained in each food item, as compared with the amounts of other competing amino acids in each food item. The amounts of various amino acids per l00g of a food item were estimated by consulting another FAO publication (FAO, 1970). The tryptophan ratio was estimated by using the formula for serum tryptophan ratio (Fernstrom, p. 416, 1981).

The factor of culture was dealt with by using only the countries of western and southern Europe. There were two additional advantages in using these countries. The statistical data for these countries would probably be more accurate than in certain other regions of the world, and there are relatively many countries in this region, which would be another advantage from a statistical point of view. The information on homicide rates in these countries was obtained from publications by the World Health Organization (WHO) of the United Nations (WHO, 1977-1982). Since the FAO data on per capita supply of foods show the average numerical values from 1975 to 1977, the average homicide rates for the same period were used. Table 1 shows the data.

Results

First, from the data in Table 1, Pearson's r was calculated. However, contrary to the hypothesis, no significant correlation was found ($r = -.275$, $N = 18$). For this reason, the countries in Table 1 were matched on the basis of similarity in terms of language, religion, standard of living, ethnic background, industrialization, or geographical location. Table 2 shows the matched countries in pairs. In this table, Pairs 1 through 6 are made up of countries which are most similar to each other within the pair, and Pairs 7 through 14 are alternative ones which are also conceivable as pairs. The examination of Pairs 1 through 6 by means of the Wilcoxon matched-pairs signed-ranks test (Siegel, pp. 75-83, 1956) yielded a significant relationship ($P < .025$, one-tailed, $T = 0$, $N = 6$), suggesting that, when social and cultural differences are minimal, low tryptophan ratios are associated with high homicide rates. For the sake of comparison, another test was made in which the most conservative result was sought by using some of the alternative pairs. In terms of the theoretical assumption for the Wilcoxon matched-pairs signed-ranks test, if we look at the numerical values of d, Pairs 5, 6, 7, 9, 11, and 14 as a sample would yield the most conservative estimate (i.e., the largest value of T). The result based on this sample showed no significant relationship, however ($T = 5$, $N = 6$, n.s.)

Discussion and Conclusion

The results of this study seem to suggest two things. First, the factor of social and cultural differences is very important. No significant correlation was found for the 18 countries as a whole, but when the countries were matched on the basis of similarity, a significant relationship was found between low levels of dietary tryptophan ratios and high homicide rates. But when different pairs were used, the significant relationship disappeared again. These results suggest that a minor difference in some aspect of society or culture could possibly affect homicide rates significantly. Second, if we obtain dietary tryptophan ratio by considering diet as a whole (rather than corn alone), we probably get a good indicator for inferring the level of serotonin in brain neurons. Certainly, we do get amino acids from a variety of sources, and methodologically, this approach is more realistic.

The future research in this area should include these two points in the design, and the most convincing way to test this hypothesis would be to conduct a clinical study by examining the dietary habits of both convicted killers and others within the same culture or subculture.

Table 1:
Dietary Tryptophan Ratios and Homicide Rates in Western and Southern Europe (1975-1977 Average)

Country	Tryptophan Ratio[1]	Homicide Rate[2]
Iceland	.028 966 9	1.06
Finland	.029 042 0	3.60
Denmark	.029 767 4	0.66
Sweden	.029 771 4	1.20
Greece	.030 474 8	0.70
Norway	.030 678 7	0.73
Italy	.031 001 3	1.35
France	.031 452 7	0.95
Austria	.031 494 2	1.40
Switzerland	.031 561 7	0.90
Malta	.031 565 8	0.30
West Germany	.031 634 9	1.23
Belgium	.031 934 3	0.90
United Kingdom	.032 207 2	1.32
Ireland	.032 209 5	0.95
Portugal	.032 847 5	1.76
Netherlands	.033 467 7	0.80
Spain	.049 908 9	0.55

[1]Trp/(Tyr + Phe + Leu + Ile + Val). See Femstrom (p. 416, 1981).
The ratio is based on mols.
[2]Per 100,000 population. Source: WHO (1977-1982)

Table 2:
Matched Pairs and Difference in Homicide Rates

Pair	Tryptophan Ratio High	Tryptophan Ratio Low	Difference in Homicide Rates (d)
1	Norway	Sweden	0.53
2	Netherlands	Belgium	0.10
3	Switzerland	Austria	0.60
4	Spain	Portugal	1.21
5	Malta	Greece	0.40
6	Ireland	United Kingdom	1.37
7	Norway	Denmark	-0.07
8	Sweden	Finland	2.40
9	Sweden	Denmark	-0.54
10	Netherlands	West Germany	0.43
11	Belgium	France	0.05
12	West Germany	Austria	0.17
13	West Germany	Switzerland	-0.33
14	Spain	Italy	0.80

References

FAO: Amino Acid Content of Foods and Biological Data on Proteins. FAO, Rome, 1970.

FAO: Food Balance Sheets 1975-1977 Average and Per Caput Food Supplies 1961-65 Average 1967 to 1977. FAO, Rome, 1980.

FERNSTROM, J.D.: Dietary precursors and brain neurotransmitter formation. Ann. Rev. Med. 32, 413-425 , 1981.

FERNSTROM, J.D. and WURTMAN, R. J.: Brain serotonin content: physiological regulation by plasma neutral amino acids. Science 178, 414-416, 1972.

MAWSON, A.T. and JACOBS, K.W.: Com consumption, tryptophan, and cross-national homicide rates. J. Orthomolecular Psychiat. 7, 227-230, 1978.

SIEGEL, S.: Nonparametric Statistics for the Behavioural Sciences. McGraw-Hill, New York, 1956.

WHO: World Health Statistics Annual, Vol. 1: Vital Statistics and Causes of Death. WHO, Geneva, 1977, 1978, 1979, 1980, 1981, 1982.