Blood Pressure and Adipose Tissue Linoleic Acid*

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Summary. In a natural, "free-living population" of 650 men, surveyed with the purpose of health assessment within an epidemiological design, a strongly significant negative correlation between the relative linoleic acid composition of adipose tissue and blood pressures was found ($P<0.001$). This correlation remained significant when age and weight were statistically controlled for. Thus, dietary, lipid-lowering linoleic acid seems to effect blood pressures as well in a favorable way.

Key words: Blood pressure - Linoleic acid - Adipose tissue - Healthy men

Experiments in animals [12] and man [1] have shown that increases in linoleic acid (C 18:2) intakes can lower elevated blood pressures. Iacono et al. [9] have shown decreases in both diastolic and systolic pressures in normotensive men when linoleic intake was raised to 5.6—7.3 cal% in diets where the overall percent of calories as fat were decreased. We determined the fatty acid composition of adipose tissue, which reflects the long term quality of fat intake [2], and tested the hypothesis of a linoleic acid—blood pressure relationship.

Materials and Methods

In the framework of an assessment survey of health and nutrition in 20—40-year-old men from Heidelberg, Germany, fat biopsies, blood pressure readings, and nutritional intakes were collected from 650 participants. Approximately 30 mg fat were biopsied from the paraumbilical region under local anesthesia, using a 19 G Yale microlance, and an adaptation of the method of Hirsch et al. [7]. The tissue was extracted into sodium chloride, and frozen. The fatty acids were later analyzed by gas liquid chromatography using a glass column packed with DEGS-PS 5% on Carbowax and a flame ionization detector, and the relative percent composition of the fatty acids determined. Blood pressure was measured in a prone position after a 10-min rest. Heights and

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weights were determined with shoes and full clothing. The nutritional intakes were recorded by a dietician, using the "24-Hour Recall" method. Statistical analyses were performed with the assistance of an S.P.S.S. 7.2 computer program on the University's IBM 370--168. Pearson's $r$ is the correlation coefficient used. Partial correlations of the first and second order were used to control for possible confounding variables.

**Results**

Table 1, with the means and standard deviations of various risk factors in our population, shows these men to be in the high-normal range of blood pressure values, not particularly overweight on the average, and enjoying a relatively fat diet. The mean linoleic acid percentage puts these men into a high-normal range as compared to other reported values [8].

Within this population, many correlations are seen between the variables determining blood pressure levels, blood pressure itself and the relative linoleic acid composition of their fat tissue (Table 2). In almost all cases the relationship is a negative one.

The negative correlation between serum cholesterol and linoleic acid can be expected, as the linoleic acid content of fat reflects polyunsaturated acid intakes, which, as illustrated by Keys' formula [10] can predictably lower serum cholesterol levels. The direct negative correlation between C 18:2, and both systolic and diastolic blood pressure in our study did come as a surprise. To determine whether this association was due to the decrease in C 18:2 with age, or with increased body weights, partial correlation coefficients of the first and second order were run on the linoleic acid-blood pressure correlation to control for weight, body fat and age. These results are seen in Table 3.

A comparison of our values before and after statistically controlling for possible confounding variables shows that a strong negative correlation ($P<0.001$) still exists when weight or relative weight differences are controlled for. This means that the relationship between C 18:2 and blood pressure, although possibly explainable through some other variable, is independent of the weight-blood pressure relationship.

**Discussion**

The previously cited studies [1, 9, 12] have shown that increased amounts of linoleic acid in the diet can, in rat and man, under experimental conditions, and over a period of time, lower blood pressure. In a non-experimental, but rather cross-sectional study design, with the advantages that observational bias, and the effects of many different, simultaneously manipulated dietary changes are not confounding the findings, we have confirmed a relationship between linoleic acid and blood pressure.