Biochemical Studies in Full-Blooded Navajo Indians

By Reuben Straus, M.D., Jarvey Gilbert, M.D., and Moses Wurm, M.S.

The Navajo Indians, who have a low incidence of coronary artery disease and a high fat intake, have also been shown to have significant elevation of serum gamma globulins. In this electrophoretic study of patterns of serum proteins it was found that adult Indians had elevated gamma globulins but that Indian children had electrophoretic patterns similar to white children. These observations indicate that the gamma globulin elevation is not an inherited characteristic in this Indian race and is probably not related to the low frequency of coronary disease.

The extensive studies of Keys and co-workers\(^1\) appear to have established a definitive correlation between the incidence of coronary heart disease with dietary habits and environment of ethnic groups. Sometimes, when these elements fail to account for the manifestation of high or low incidence of coronary artery disease in particular populations, some workers\(^2,3\) have drawn upon a hereditary difference as the basis of explanation. This particularly has been the case for the Navajo Indians in whom there has been demonstrated a remarkably low incidence of coronary artery disease, and whose diet, with respect to fat intake, is little different from the normal American population.\(^4,5\)

It is the purpose of this report to present our findings with regard to the protein composition of the serum of the Navajo Indian.

Material and Methods

A random sample of 25 adult full-blooded male Navajo Indians, ages 25 to 78 years, residing on the Reservation in Fort Defiance, Arizona, was used in this study. The subjects were believed clinically not to have coronary artery disease, and were selected on this basis upon their appearance as outpatients at the local hospital for a variety of minor ailments. Blood was drawn, and immediately after the clot was formed the serum was separated and forwarded to our laboratory, so that the analysis was started within 48 to 72 hours after the specimen was taken.\(^6\)

A second group of 28 full-blooded Navajo Indian children between the ages of 3 and 15 years, living on the Reservation in Shiprock, New Mexico, were also studied. Blood from these apparently healthy children was secured on a voluntary basis, and specimens were handled in a manner similar to that of the preceding group.

The sera were analyzed by paper electrophoresis, according to the procedure previously described.\(^7\)

Results

Table 1 shows the relative concentration of the 5 major protein components of human serum found in the group of 25 adult males. The mean relative concentration of albumin for this group was 49.0 per cent, which appears not to be significantly different from the normal values obtained in a healthy white population. The mean relative concentration of alpha-1 globulin, alpha-2 globulin, and beta globulin, respectively, are 4.2, 8.8, and 13.1 per cent, all within the range considered normal. The mean relative concentration of gamma globulin of 24.9 per cent, however, is significantly elevated compared to that of a normal white population. With the exception of 3 persons who had normal gamma globulin values, all the remaining specimens ranged higher than the upper limit of normal for a white population.

In order to establish whether or not the elevated gamma globulins observed in these adult Indians represented a genetic or acquired characteristic, a similar analysis in Navajo children was carried out. Table 2 presents the data obtained on relative concentration of protein fractions in the serum.
BIOCHEMICAL STUDIES OF NAVAJO INDIANS

TABLE 1.—Relative Concentration of Serum Proteins in Adult Navajo Indians

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sex</th>
<th>Age</th>
<th>Albumin (%)</th>
<th>A-1 glob. (%)</th>
<th>A-2 glob. (%)</th>
<th>B glob. (%)</th>
<th>G glob. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T.Y.</td>
<td>M</td>
<td>54.9</td>
<td>5.7</td>
<td>7.3</td>
<td>12.0</td>
<td>22.7</td>
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<tr>
<td>H.K.B.</td>
<td>M</td>
<td>65</td>
<td>56.5</td>
<td>4.1</td>
<td>8.2</td>
<td>11.1</td>
<td>20.1</td>
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<td>H.N.</td>
<td>M</td>
<td>58</td>
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<td>9.0</td>
<td>10.5</td>
<td>11.2</td>
<td>24.5</td>
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<tr>
<td>S.</td>
<td>M</td>
<td>25</td>
<td>61.0</td>
<td>3.6</td>
<td>6.3</td>
<td>9.7</td>
<td>19.4</td>
</tr>
<tr>
<td>T.W.</td>
<td>M</td>
<td>48</td>
<td>62.0</td>
<td>3.1</td>
<td>5.8</td>
<td>11.1</td>
<td>19.4</td>
</tr>
<tr>
<td>P.C.</td>
<td>M</td>
<td>25</td>
<td>61.0</td>
<td>3.6</td>
<td>6.3</td>
<td>9.7</td>
<td>19.4</td>
</tr>
<tr>
<td>W.Y.</td>
<td>M</td>
<td>42</td>
<td>58.8</td>
<td>3.9</td>
<td>8.2</td>
<td>12.2</td>
<td>19.6</td>
</tr>
<tr>
<td>M.Y.</td>
<td>M</td>
<td>57</td>
<td>61.1</td>
<td>3.2</td>
<td>5.8</td>
<td>10.6</td>
<td>19.6</td>
</tr>
<tr>
<td>R.K.</td>
<td>M</td>
<td>69</td>
<td>49.7</td>
<td>2.0</td>
<td>6.3</td>
<td>12.6</td>
<td>29.5</td>
</tr>
<tr>
<td>J.C.</td>
<td>M</td>
<td>53</td>
<td>6.1</td>
<td>9.4</td>
<td></td>
<td>11.9</td>
<td>22.4</td>
</tr>
<tr>
<td>A.N.</td>
<td>M</td>
<td>71</td>
<td>35.6</td>
<td>6.1</td>
<td>13.5</td>
<td>12.6</td>
<td>32.2</td>
</tr>
<tr>
<td>S.S.</td>
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<td>44</td>
<td>54.2</td>
<td>3.6</td>
<td>5.0</td>
<td>10.3</td>
<td>27.0</td>
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<td>E.B.</td>
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<td>3.7</td>
<td>12.7</td>
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<td>14.9</td>
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<td>4.9</td>
<td>7.7</td>
<td>11.0</td>
<td>19.5</td>
</tr>
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<td>M.</td>
<td>M</td>
<td>39</td>
<td>5.5</td>
<td>10.1</td>
<td></td>
<td>11.1</td>
<td>34.3</td>
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<td>50</td>
<td>45.0</td>
<td>3.6</td>
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<td>29.4</td>
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<td>M</td>
<td>68</td>
<td>32.7</td>
<td>3.9</td>
<td>10.6</td>
<td>17.2</td>
<td>35.6</td>
</tr>
<tr>
<td>B.</td>
<td>M</td>
<td>73</td>
<td>47.7</td>
<td>6.1</td>
<td>9.5</td>
<td>7.8</td>
<td>28.8</td>
</tr>
<tr>
<td>M.B.</td>
<td>M</td>
<td>45</td>
<td>46.6</td>
<td>6.0</td>
<td>9.1</td>
<td>20.8</td>
<td>17.5</td>
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<tr>
<td>F.J.</td>
<td>M</td>
<td>69</td>
<td>49.4</td>
<td>2.9</td>
<td>8.0</td>
<td>13.3</td>
<td>26.4</td>
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<tr>
<td>P.T.</td>
<td>M</td>
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<td>48.0</td>
<td>3.8</td>
<td>6.5</td>
<td>15.8</td>
<td>25.9</td>
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<tr>
<td>G.F.</td>
<td>M</td>
<td>62</td>
<td>45.4</td>
<td>3.9</td>
<td>9.1</td>
<td>15.5</td>
<td>26.1</td>
</tr>
<tr>
<td>R.S.</td>
<td>M</td>
<td>64</td>
<td>37.2</td>
<td>3.6</td>
<td>7.8</td>
<td>18.2</td>
<td>33.2</td>
</tr>
<tr>
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<td>M</td>
<td>66</td>
<td>42.8</td>
<td>4.6</td>
<td>9.2</td>
<td>15.2</td>
<td>28.2</td>
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<tr>
<td>T.L.</td>
<td>M</td>
<td>68</td>
<td>43.4</td>
<td>5.7</td>
<td>13.4</td>
<td>13.4</td>
<td>24.2</td>
</tr>
</tbody>
</table>

Mean 49.0 4.2 8.8 13.1 24.9
Standard deviation 7.9 1.1 2.3 2.9 5.7

Normal white 50-60 4.8 8.10 12.14 12.18

of this group. It will be noted that the mean value of most of the fractions is consistently within the range of normal found in a healthy group of white children. White children do not show significant deviations from the range of values for white adults. There are, however, 8 instances of significant increases of gamma globulins. The remaining 20 are within the normal range.

DISCUSSION

Our observations on adult Navajo Indians confirm the previously published data of Page, Lewis, and Gilbert to the effect that they show an elevated gamma globulin.

The significance of changes in individual protein fractions, as well as the over-all protein pattern, has been well reviewed by Sunderman and Sunderman7 and Fisher.5 Our experience during the past 5 years confirms these observations and frequently has enabled us also to make a specific diagnosis based upon characteristic alterations in the protein pattern. Although the child Navajo population as a whole displays a normal relative concentration of all protein fractions, it should be noted that in 8 cases there were moderate increases of gamma globulin. Such changes, particularly within the ranges noted, generally indicate an antibody response to an infectious process, which may be mild, either acute or chronic, and sometimes even subclinical.

Some of the individual protein patterns displayed by the adult population, on the
other hand, are more complex and probably reflect more than a single disease process. For example, R.S. and C.J.M., by virtue of a markedly reduced albumin, elevated beta and gamma globulins, display the protein profile suggestive of liver disease. F.J. and H.K.B., on the other hand, in whom the only major alteration was found to be a marked increase in gamma globulin, possibly reflects repeated infections over a long period of time.

Since the Indian children present electrophoretic protein patterns that resemble a typical white population, it is concluded that a genetic difference does not exist, at least with respect to relative concentration of serum proteins.

It is, therefore, logical to assume that the elevated gamma globulins observed in the adult Navajo are the result of continued exposure to infection or other disease processes rather than of an inherited characteristic. It would be expected that similar gamma globulin levels would be found among people in lower economic groups, or in primitive societies where environment and long-term survival favor frequent infections.

It is our opinion, therefore, that the elevated levels of gamma globulin are not related to the low incidence of coronary artery disease in these people. Keys et al. stated that the diet of the Navajo Indian is not high in total fats and that there are no reliable data on the frequency of coronary sclerosis. On the other hand, one of us, over a 2-year period of resident observation, substantiates both the high level of fat ingestion and the infrequent occurrence of arteriosclerotic heart disease. In this connection a study of the lipid spectra in the Navajo Indian would be profitable.

Whether or not debilitating diseases may operate to reduce the incidence of atherosclerosis, particularly coronary artery disease, as has been reported by Rogers, cannot be determined from the data presented here. Another study correlating coronary artery disease with lipid and lipoprotein findings in tuberculous patients is in progress and will be reported elsewhere.

**Summary**

Adult full-blooded Navajo Indians show significant changes in serum proteins, particularly elevation of the gamma globulins.

When protein profiles of full-blooded Navajo Indian children are examined, the concentration of the protein fractions is found essentially similar to that of a non-Indian population.

It is concluded that the hypergammaglobulinemias are not genetically determined but are the result of disease processes.

From our study, there appears to be no relationship between the increase in gamma globulin concentration among adult Navajos and the low incidence of coronary artery disease.

**Sommaio in Interlingua**

Adulter indians navajo de racia pur revela significative idiosyncrasias del proteinas seral. Es specialmente a notar elevationes del globulinas gamma.

Quando le profilos del proteinas de juvenil indians navajo de racia pur es examine, le concentration del fractiones de proteina se revela como essencialmente simile a illo del population non-indian.

Es conclude que le hypergammaglobulinemias del indians navajo adulte non es genetically determinate sed representa le resultato de processos pathologic.

Secundo nostre dados, il non pare existir un correlasion inter le augmentate concentration de globulina gamma in navajos adulte e lor basse incidentia de morbo de arteria coronari.

**References**


3. Hufnagel, W. C.: Pathogenesis of athero-


These investigators employed a method of gas-liquid chromatography which makes possible the direct isolation, identification, and analysis of all fatty acids between C₄ and C₂₀. The study consisted of an analysis of these fatty acids in 12 coronary artery patients and 12 controls matched as to age and sex and without clinical evidence of coronary artery disease. Red cells, plasma phospholipid, and plasma acetone-soluble fractions were analyzed. The first 2 showed no difference in the proportion of fatty acids between patients and controls. In all 3 fractions the "essential fatty acids," linoleic and arachidonic, were about the same in the 2 groups. In the acetone-soluble fraction of plasma (containing cholesterol esters acid glycerides) there was some suggestion of an increase in the mono-unsaturated C₁₆, C₁₈ and C₂₀ acids in coronary artery patients compared with the controls. Particularly the ratio of the most abundant of these acids (oleic) to its corresponding saturated acid (stearic) was higher in the patients with coronary artery disease. Since diet seemed to have been identical in the 2 groups, the possibility of a metabolic defect in the coronary artery patients was suggested.

McKusick
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Circulation. 1959;19:420-423
doi: 10.1161/01.CIR.19.3.420
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
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