A Biochemical Evaluation of the Nutrition Status of Rural and Urban Pedi Males

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SUMMARY
The biochemical results of nutrition status surveys, carried out on rural and urban Pedi males during August 1970 and March 1971, respectively, were evaluated in terms of nutrition status. In general, the nutrition status of both groups appeared to be satisfactory, except for nicotinic acid nutrition, especially among rural Pedi. These results were similar to those found in a previous study on Venda males.


In continuation of the International Biological Programme (Human Adaptability Section), nutrition status surveys were carried out on rural and urban Pedi males during August 1970 and March 1971, respectively. In this report, the results of these surveys will be discussed and compared with those of similar surveys carried out on rural and urban Venda during May - June 1968, and September - October 1968, respectively.

MATERIALS AND METHODS
For the rural survey, a random sample of 204 adult Pedi males was taken from the Chieftaincy of Paramount Chieftainess Mankopodi Thulare Sekhukhune, at Mohlahletsi near Paradys in the Geluks location, district Lydenburg. For the urban survey, a random sample of 239 adult Pedi males was taken from Katlehang township in the Germiston area.

Blood samples were drawn and serum collected for the determination of cholesterol, triglycerides, total protein, vitamin C, vitamin A and carotene. A Beckman microzone electrophoresis system, using cellulose acetate membranes, was used for the separation of the serum protein fractions. Three- to four-hour urine samples were collected and preserved with oxalic acid for the determination of creatinine, riboflavin, N-methyl-nicotinamide (N-Me) and N'-methyl-2-pyridone-5-carboxamide (2-pyridone). In all, 22 quantitative variables were measured and recorded (Table I).

Statistical Analyses
It is important to check whether the rural and urban populations differ from one another in any concomitant variable which may be responsible for explaining differences eventually to be established in the biochemical variables. An obvious case is the age of the 2 populations. A chi-square test was used to test for significant differences in age distribution.

A multivariate analysis of variance was done on the 22 variables to test the hypothesis of no difference between the vector mean values of the 2 populations. If a significant difference is established by means of the abovementioned test, it is then necessary to find out which variables are responsible for such a significant difference. This was done by means of a Student's t-test on each of the 22 variables. However, when several such tests are performed on interrelated variables, individual tests should be done at a significance level which is smaller than the level required for the over-all hypothesis; this controls the over-all error rate. A result, frequently used to approximate the level of the individual tests, which guarantees an over-all a-level of significance, derives from the Bonferroni inequality: if there are k-tests at level a/k, the over-all level approximates a. For the 22 variables under consideration the individual significance was selected at 0.05 + 22 = 0.00227 to guarantee an approximate 0.05 over-all error rate.

RESULTS AND DISCUSSION
The object of these surveys was to study man's adaptation from a rural to an urban environment. From a nutritional point of view, the following factors render the interpretation of the results difficult:

The survey on rural Venda was carried out during the autumn, and that on rural Pedi during early spring, while the survey on urban Venda was done during spring and on urban Pedi during autumn. Small differences in the results obtained between the urban and rural groups, especially in the case of parameters such as vitamins A and C, might therefore have been the result of seasonal differences in eating habits due to the availability of food.

The rural Venda survey was done near Sibasa, in a high-rainfall area, while the rural Pedi survey was done near Lydenburg, a low-rainfall area. Differences between the 2 rural groups, therefore, as well as between rural and urban, may reflect differences in the environment and the availability of foods, rather than the effects of urbanisation. Since no dietary surveys were conducted on the Pedi, only speculation is possible in this respect.

There was no significant difference between the age distribution of the 2 groups (P > 0.99). For the multivariate analysis, the computed F-value was F = 20.36, and the critical F-value at a 5% level was F22,24 (0.05) = 1.57. The
When the level of protein nutrition has not yet been established, although work by the NRIND has indicated that there is an inverse relationship between animal protein intake and serum α- and γ-globulin. Since racial differences can be excluded in this study, the most probable reasons for the differences obtained in the serum globulin fractions of the urban and rural groups are differences in exposure to infections or differences in dietary patterns.

The albumin values for rural and urban Pedi did not differ significantly (Table I). The significant differences in albumin as a percentage of total protein and the albumin/globulin ratio can be ascribed to the difference in total serum protein concentrations, or to differences in γ-globulin concentrations. It has been previously shown that total protein does not constitute a good index of nutrition status. When the albumin values were classified according to the standards of the Interdepartmental Committee on Nutrition for National Defence (ICNND) (Table II), it was found that only one subject could be classified as being in the deficient range, while 2.5% and 5.1% of rural and urban Pedi respectively could be classified as being in the low range of protein nutrition. These results agree very well with those obtained by classifying the albumin as a percentage of total protein according to the standards of the Interdepartmental Committee on Nutrition for National Defence (ICNND). To what extent concentrations of the serum globulin fractions reflect the protein nutrition status of an individual? To what extent concentrations of the serum globulin fractions reflect the protein nutrition status of an individual? To what extent concentrations of the serum globulin fractions reflect the protein nutrition status of an individual?
et al.,) 11.3% and 7.6% of rural and urban Pedi respectively fell into the low range. It seems, therefore, that the sliding scale proposed by Du Plessis and co-workers is in better agreement with the results obtained using albumin values than is the Oberman standard.

In contrast to the results obtained for the rural Venda, no indication of protein deficiency was found among either urban or rural Pedi males.

There was a significant, though small, difference between the serum cholesterol values obtained for rural and urban Pedi males, but no significant difference was found between the triglyceride values for the 2 groups (Table I). Both cholesterol and triglyceride levels were found to be appreciably lower than those obtained for the Venda males. The cholesterol values were, however, similar to those found for Bantu schoolchildren in Pretoria. In the Pedi surveys, only one cholesterol value (0.5%) exceeded 280 mg/100 ml, while 13.2% of both rural and urban triglyceride values were above 150 mg/100 ml. This incidence of high values is lower than that found among the Vendas (8.14% for cholesterol, and 25-28% for triglycerides).

It should be noted that, in both the Pedi and Venda surveys, slightly higher cholesterol and triglyceride values were obtained after the winter, i.e., among rural Pedis and urban Vendas. The differences found may therefore be seasonal, resulting from changes in the availability of food.

As could be expected, seasonal factors seem to have a marked influence on the results for both vitamin A and C (Tables I and III). Higher values were obtained in the autumn for serum carotene and serum and blood vitamin C, and lower values for vitamin A (i.e., for rural Venda and rural Pedi). The incidence of low values follows the same pattern (Table III). A higher incidence of low values was found in spring for serum carotene and vitamin C, and a lower incidence for serum vitamin A (i.e., among urban Venda and rural Pedi). The differences found in both surveys between the rural and urban groups for vitamin A and C seem to be largely due to seasonal differences and to a lesser extent to adaptation to an urban environment.

Seasonal and climatic conditions, as well as the effects of liver vitamin A stores on serum vitamin A levels, could explain the differences between the results for serum vitamin A and carotene. In the summer, the intake of carotene-rich foods could be expected to be relatively high, whereas it is possible that more fat and vitamin A-rich foods were consumed during the winter. This could at least partially explain the relatively low carotene values found for rural Pedi, and the high vitamin A values for urban Venda in the spring, especially if the extremely dry conditions during the rural Pedi survey are taken into account.

There was a big difference in blood vitamin C levels of the 2 groups, those of the Pedi being about half those of the Venda. The results, from classification of serum and blood vitamin C values according to ICNN standards and standards proposed by Du Plessis respectively, were, therefore, much more similar than those obtained in the Venda surveys. The reason for this disparity is not known. Racial, climatic or dietary factors may be involved. It is also possible that the 2 parameters do not measure the same variable, i.e., blood vitamin C may reflect body stores to a greater extent than does the serum vitamin C.

Although the incidence of low values for serum vitamin A for the urban Pedi (22.6%) is higher than that for rural Pedi (1.5%) (Table III), this is probably a seasonal occurrence, as is also the case with the high incidence of low carotene (35.5%) and serum vitamin C values (41.4%) among rural Pedi. Since there is little clinical evidence of vitamin A or C deficiencies among the South African Bantu population, the fact that a seasonally higher incidence of subclinical vitamin A and C deficiencies was found is probably of minimal nutritional importance.

No significant difference was found between the riboflavin values of urban and rural Pedi. The percentages of values that could be classified as low (2.9% and 6.9%) or deficient (0.5%) according to the ICNN standards was low (Table IV).

<p>| TABLE IV. INCIDENCE OF LOW VALUES: RIBOFLAVIN |
|-------------------|-------------------|-------------------|-------------------|</p>
<table>
<thead>
<tr>
<th>Riboflavin (µg/g creatinine)</th>
<th>Deficient</th>
<th>Low</th>
<th>Acceptable</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural (%)</td>
<td>0.5</td>
<td>6.9</td>
<td>43.1</td>
<td>49.5</td>
</tr>
<tr>
<td>Urban (%)</td>
<td>—</td>
<td>2.9</td>
<td>54.4</td>
<td>42.7</td>
</tr>
</tbody>
</table>

These results agree very well with those obtained for the Venda. Although no dietetic survey was done, it is possible that the consumption of Bantu beer could effectively have supplemented the riboflavin intake of the Pedi, as was the case with the Venda. In contrast to what has been found in Bantu children, riboflavin deficiency seems to be of much less importance in both the rural and urban Pedi adult male populations.
The results for nicotinic acid (Tables I and V) show significant differences between urban and rural Pedi for 2-pyridone and the 2-pyridone/N'-Me ratio, but not for N'-Me. The classification of values according to the standards proposed by Nel and Du Plessis, show comparable changes. It is therefore possible that the high incidence of low values found could have been aggravated by seasonal changes, since the rural Pedi survey was carried out shortly after the winter season. It is, however, not possible, on the basis of these 2 studies, to assess what effect, if any, seasonal changes have on nicotinic acid status.

### Table V. Incidence of Low Values: Nicotinic Acid

<table>
<thead>
<tr>
<th></th>
<th>Deficient</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;2.0</td>
<td>2.0 - 3.9</td>
<td>≥4.0</td>
</tr>
<tr>
<td>Rural (%)</td>
<td>1.6</td>
<td>35.1</td>
<td>63.3</td>
</tr>
<tr>
<td>Urban (%)</td>
<td>2.9</td>
<td>43.9</td>
<td>53.1</td>
</tr>
</tbody>
</table>

The incidence of low values for these 2 parameters among rural Pedi, is considered to be the main deficiency.

### Conclusions

In general, it can be said that the nutrition status of both urban and rural Pedi seems to be acceptable, especially with regard to protein and riboflavin. The vitamin A and C nutrition status seems less adequate than is the case among the Venda. Nicotinic acid nutrition, especially among rural Pedi, is considered to be the main deficiency. Except in the case of nicotinic acid, the nutrition status of the urban and rural groups does not differ appreciably.

### References