BIOCHEMICAL EVALUATION

A. NEL, J. P. DU PLESSIS AND S. A. FELLINGHAM

SUMMARY

Comprehensive nutrition status surveys were carried out on 253 rural and 247 urban adult Venda males. The biochemical findings in respect of the protein nutrition status of the two groups showed no sign that any widespread deficiency was present in the urban Venda population. In the rural group, however, 2·8% could be assigned to a 'deficient' range and a further 26·9% to a 'low' range.

The cholesterol and triglyceride values for the two groups did not differ significantly, although the incidence of high values was lower in the rural group.

The serum vitamin-A levels did not indicate the presence of a deficiency in either population group despite low carotene values in 5% of the rural and 24% of the urban groups. Low serum vitamin-C levels were found in 28% of the rural and 41% of the urban groups.

Since the ICNND scales for interpreting N^1-Me values are not considered acceptable, a new scale is postulated, and is used also for interpreting the 2-pyridone values. The indications are that approximately 60% of the rural and 47% of the urban groups can be considered sub-optimal in regard to nicotinic acid nutrition. There were very few signs of riboflavin deficiency in either population group. This apparent contradiction can probably be ascribed to the large amount of Bantu beer consumed by both groups.

In general, the level of nutrition of the rural Venda appears to be appreciably lower than that of the urban population. The nutrition status of both groups can be considered adequate, except in regard to nicotinic acid and, to a lesser extent, vitamin C.

Blood samples were drawn for the assay of total serum proteins,[1] cholesterol,[2] triglycerides[3,4] and vitamins A[5] and E.[6,7] A Beckmann microzone system using cellulose acetate membranes was used for the separation of the serum protein fractions.

Urine specimens were collected over a period of two hours and assayed for riboflavin,[8,9] N^1-methylnicotinamide[10] (N^1-Me), N^1-methyl-2-pyridone-5-carboxylamide (2-pyridone)[11] and creatinine.[12]

The purpose of the statistical analyses was to ascertain whether the biochemical variables were influenced by age and whether the results obtained for the rural and urban groups differed significantly, the influence of age having been eliminated in the latter tests were applicable.[13] A 5% level of significance was used throughout.

RESULTS AND DISCUSSION

Total Serum Protein

Total serum protein concentration has been shown to have little relation to protein status except perhaps in cases of gross undernutrition. This assay was therefore carried out only in order to convert to weight units the percentages obtained from the protein electrophoresis.

Serum Albumin

The serum albumin concentration was previously shown to be the best criterion of protein nutrition status.[14] The classification used by the Interdepartmental Committee on Nutrition for National Defense (ICNND)[15] was applied to the serum albumin values of both surveys. In the urban group 2·4% could be considered to be in the 'low' range of protein nutrition. This finding agrees very well with the results of the Pretoria surveys where less than 3% were found to be in the 'low' range (Fig. 1). In the rural group, however, 2·8% could be classified as 'deficient' and a further 26·9% as being in the 'low' range. The mean serum albumin values were 3·81 and 4·21 g/100 ml for the rural and urban groups respectively. The results obtained for the two groups differed significantly. It is thus obvious that the protein nutrition status of the urban group was substantially superior to that of the rural group.

Cholesterol and Triglycerides

No significant difference was found between the cholesterol and triglyceride values for the two groups. The mean cholesterol values for the rural and urban groups were 219 and 231 mg/100 ml respectively. The mean triglyceride levels were 122 and 135 mg/100 ml for the rural and urban groups respectively.

The rural group showed a lower frequency of 'high' values in both determinations, when 280 mg/100 ml serum was taken as the upper limit for the normal range for cholesterol and 150 mg/100 ml serum for triglycerides (Fig. 1).[16]

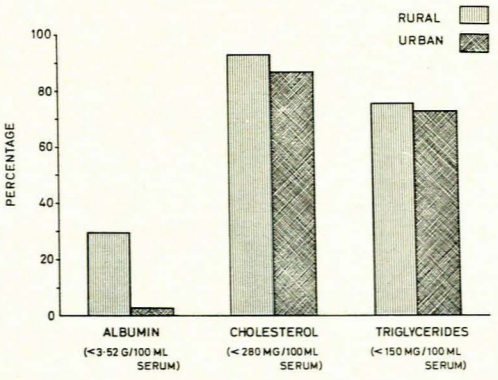

Fig. 1. Incidence of low serum albumin values and normal cholesterol and triglyceride values.

In a previous study[9] during 1963 median values of 158 and 166 mg/100 ml serum were found for Bantu children of 7 - 11 and 12 - 15 years, respectively. These results were in agreement with those found by Walker and Arvidsson (1954)[17] and Bronte-Stewart *et al.* (1955)[18] for urban adult Bantu males. During recent years, however, Walker[19] found a mean value of 212 mg/100 ml for Bantu male teachers in Johannesburg and Hathorn *et al.*[20] found a mean value of 215 mg/100 ml for Zulu males of 30 - 50 years.

The results obtained in the Venda study are, therefore, not unusually high when seen in relation to the last two studies. The possibility that there may be a tendency to higher cholesterol levels in the Bantu population due to the influence of westernization upon their dietary habits should be considered. Walker and Arvidsson[17] found an increase of 11 mg/100 ml in their partially westernized subjects compared with Bantu subjects living a more traditional way of life.

It has also been shown in children that an increase in cholesterol content is associated with an increase in the intake of fat and animal protein.[14] It is, however, probable that this finding will also be valid in adults. According to the theory of Albrink,[21] a high triglyceride value indicates overnutrition in general rather than an increased intake of dietary fat.

Although they are not significant, the differences in lipid levels found between the rural and urban groups, therefore, indicate that there is a generally higher level of nutrition in the urban than in the rural group.

Vitamin A and Carotene

For both the serum vitamin A and carotene values, significant differences were found between the rural and urban groups. An evaluation of serum vitamin-A levels in terms of the ICNND standards[15] showed no signs of vitamin-A deficiency in either population group. In contrast, low carotene levels were found in 5% of the rural and 24% of the urban groups (Fig. 2). This apparent contradiction in the results for vitamin A and carotene can probably be explained by seasonal differences at the time of the survey, the influence of liver reserves on serum vitamin-A levels and the consumption of preformed vitamin-A during the winter. In spite of the low carotene values, it may, however, be safely assumed that vitamin-A deficiency is not a nutritional problem in these population groups.

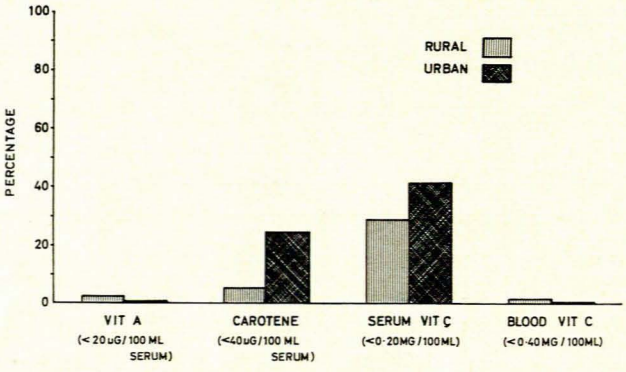

Fig. 2. Incidence of low serum vitamin A, carotene and serum and blood vitamin-C values.

Vitamin C

Both serum and whole blood vitamin-C levels were determined. The results obtained showed a significant difference between the two groups in respect of the serum levels but not in respect of the blood levels. For both variables, higher values were obtained in the rural than in the urban group, the mean serum levels being 0·47 and 0·33 mg/100 ml and the blood levels 1·18 and 1·11 mg/100 ml respectively. When the ICNND's classification was applied to the serum values, it was found that 28% of the rural and 41% of the urban group could be regarded as being in a low range of vitamin-C intake (Fig. 2). In contrast, an application of the scale of interpretation for blood vitamin-C levels, suggested by Du Plessis showed that only approximately 1% of the values in both the urban and rural groups could be regarded as being low. It is difficult to explain this difference in the interpretation of results for serum and blood vitamin C. The difference between the mean serum and blood levels is substantially larger, however, than that found in the Pretoria Coloured and Indian surveys and it is therefore possible that the standards of interpretation suggested by Du Plessis may be too low.

Nicotinic Acid Status

The limits of 0·5 and 1·6 mg/g creatinine used by the ICNND[15] to evaluate the 'low' range of N^1-Me excretions are considered to be extremely low. It has previously been shown that pellagra patients excrete N^1-Me at a rate which would place them in the 'acceptable' group when the above classification is used.[22] We therefore suggest that the scale for N^1-Me excretions be changed to the following:

<2 mg/g creatinine—deficient
2·0 - 3·9 mg/g creatinine—low
⩾4 mg/g creatinine—high

We have also used the same classification for the interpretation of 2-pyridone values and have accepted the suggestion of De Lange and Joubert[23] that 2-pyridone/N^1-Me ratios of less than 1·0 be regarded as indicative of subclinical nicotinic acid deficiency.

Fig. 3 illustrates the incidence of 'low' values found for the 3 parameters, indicative of nicotinic acid deficiency. It is obvious that the 3 parameters give essentially the same results. Approximately 60% of the rural and 7% of the urban groups could be considered to be in a sub-optimal range of nicotinic acid nutrition. The results obtained for the urban group agree very well with those

of the Pretoria surveys.[9] It is thus obvious that nicotinic acid deficiency constitutes one of the greatest nutritional hazards in the Bantu population of South Africa.

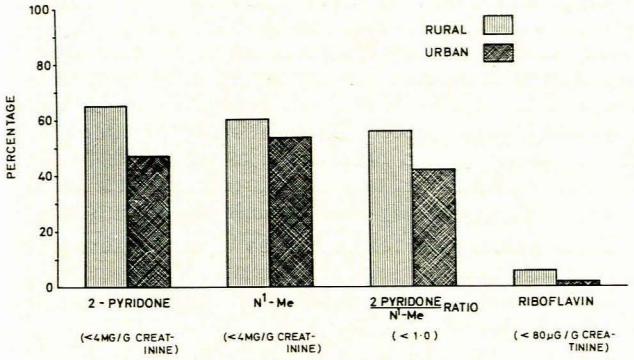

Fig. 3. Incidence of low urinary excretions of nicotinic acid metabolites and riboflavin.

Riboflavin

Compared with the results of the Pretoria surveys,[9] where subclinical riboflavin deficiency was found to be even more prevalent than nicotinic acid deficiency, it was most surprising to find such a low incidence of low riboflavin excretion values in the two groups (Fig. 3). In our opinion, the ICNND scales[15] of interpretation of 'deficient' (<27 µg/g creatinine) and 'low' (27 - 79 µg/g creatinine) ranges are extremely low. Since we have not had any practical experience of work on clinical riboflavin deficiency, we do not feel justified in suggesting changes in the scales of interpretation.

It is, however, possible that the consumption of Bantu beer by the adult Bantu male could explain the relative discrepancy between the results obtained for riboflavin and nicotinic acid. The dietetic indications are that, with few exceptions, Bantu beer is consumed in large quantities—at least 1 litre per person per day in both the rural and urban groups. According to Novellie,[24] 1 litre of Bantu beer from the urban breweries would provide roughly one-third of the minimum daily requirement of riboflavin and one-fifth of that of nicotinic acid. Since the production of Bantu beer is largely based upon maize, it could be that the nicotinic acid content is, to a large extent, present in a bound form unavailable to man. It is thus possible that the high consumption of Bantu beer would effectively supplement the intake of riboflavin but not that of nicotinic acid in both population groups.

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