CLINICAL EVALUATION

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SUMMARY

The results of a clinical survey to assess the nutritional status of a rural and an urban group of Venda are reported. In addition the results of the clinical and the biochemical methods of evaluating nutrition status in respect of vitamins A and C, carotene, riboflavin and nicotinic acid are compared.

In both localities an over-all significant effect of age (at the 5% level) on the incidence of traumatic cheilosis, gingivitis, xerosis, follicular hyperkeratosis, a combination of the last two in the same subject, and pellagra was found. The percentages of incidence indicated that the incidence of the above signs, except in the case of traumatic cheilosis, increased with age. The incidence of the latter decreased with age.

Traumatic cheilosis appeared to be an expression of the ambient conditions of work and life. By deduction, this finding confirms the previous opinion that traumatic cheilosis is not associated with a nutrient deficit. Only one case of nutritional cheilosis, which is to a great extent related to riboflavin deficiency, was found among the total number of test subjects. Thus it appeared that the riboflavin status was satisfactory. This opinion is confirmed by the biochemical evaluation.

Considering the separate age-groups, the rural subjects suffered more frequently from gingivitis than the town dwellers, except in the group of 50 years and older. However, a significant difference between the two localities occurred only in the 40 - 49-year age-group. The condition is ascribed to a deficiency of vitamin C, and connected to the increasing consumption of beer and 'mahewu' (at the expense of normal diet) with increasing age. According to the biochemical findings, more urban than rural Venda suffered from inadequate vitamin-C intakes. On the whole it can be stated, however, that in both localities up to 40% of the subjects appeared to have obtained suboptimal quantities of vitamin C in their diets.

Up to 20% of rural and up to 33% of urban Venda male subjects suffered from skin lesions which could be related to a deficit of metabolically active vitamin A. The rural Venda, however, suffered from a lesser degree of metabolically active vitamin-A deficit than the urban. Among the rural Venda the deficit was aggravated by a deficient intake of balanced proteins, and among the urban by a deficit of carotene in the diet.

Overt pellagra occurred only among the subjects older than 40 years; in 7% of the rural and in 2% of the urban subjects. The clinical findings on the nicotinic acid deficiency do not contradict the biochemical findings, which indicate the preclinical conditions.

The primary purpose of this section of the survey was to assess on clinical evidence the nutritional status of each group and to investigate the effect of the locality, i.e. rural or urban, on the incidence of the clinical signs which could be associated with malnutrition.

METHODS

The examinations for signs of malnutrition were confined to the superficial structures, i.e. the skin and the gingiva. Epithelial changes on the lips, gums and the skin were the more common occurrences and are discussed below.

The various criteria for establishing the presence of the above signs and the grouping of the individual signs into categories have been described before,[1] and were adopted to classify the relevant clinical data of this survey. The presence or absence of the conditions was listed on the extensive clinical examination forms, which had been developed since 1961 by the Division of Field Studies of the NNRI. The signs used for the identification of each category are recapitulated below. No attempt was made to assess the severity of a condition.

Nutritional cheilosis is the swelling and vertical fissuring of the lips, and maceration with or without active fissuring of the angles of the mouth. Traumatic cheilosis is characterized by desquamation, singly or in combination with swelling of the lips, in the same individual, and is not regarded as a sign of malnutrition.

Gingivitis is a diffuse swelling of the gums and the interdental papillae, extending well upwards between the teeth and overlapping onto the adjacent tooth margins. Sometimes it is associated with redness and bleeding of the gums on light pressure. Redness, swelling and bleeding of the gums limited to the bases of the incisor teeth were often noticed and were usually associated with gross local retraction of the gums. Such cases were not classified as gingivitis.

Among the test subjects of this survey, localized gingivitis occurred mostly in the tobacco chewers, who were in the habit of inserting tobacco, the juice of which is a potent irritant, between the lips and the incisor teeth. The subsequent chronic irritation caused considerable localized redness, swelling and gum retraction. General redness of the gums, unaccompanied by swelling, was not included within the diagnostic context of gingivitis.

Of the skin conditions which were encountered and which are commonly associated with malnutrition, only xerosis and follicular hyperkeratosis occurred.

Xerosis is a dry, desquamating condition of the skin. Often a shiny mosaic condition without excessive dryness was noticed; this was not taken as xerosis.

Follicular hyperkeratosis is a raised condition of the hair follicles with hard, dry protruding cores. Fine and coarse types were encountered. As recommended by Rao,[2] these two types were regarded as one and the same condition, the coarser being a more advanced degree of the finer type.

Besides the above skin lesions, others were noted which are classically associated with pellagra. A nutritional condition of doubtful origin was found among the urban males. This consisted of a dark pigmentation and thickening of the ankles with horizontal cracking and ridging on their anterior surfaces.

RESULTS

The number of subjects in each 10-year age-group is presented in Table I. It should be noted that the rural sample was loaded in the 20 - 29-year group, whereas the urban sample was loaded in the 40 - 49-year group. This imbalance of the two groups in respect of age was unavoidable and resulted from practical difficulties during the field work in obtaining a sample more evenly stratified according to age.

TABLE I. CELL SIZES OF EACH AGE-GROUP OF RURAL AND URBAN VENDA MALES INCLUDED IN THE SURVEY

	Age-groups (years)					
Locality	Below 20	20 - 29	30 - 39	40 - 49	50 +	Total
Rural	**11**	**123**	**42**	**55**	**26**	**257**
Urban	**7**	**35**	**57**	**103**	**46**	**248**

Where the stated ages obviously did not agree with the estimated ages, the latter were accepted after consultation with three or four experienced examiners. Even so there could still have been a considerable margin of error. Therefore, the 'accepted' ages were classified into 10-year groups, and the calculations and the discussion are based on this age classification. Since in both localities the number of subjects under the age of 20 years was small in comparison with the other age-groups, these two groups are omitted in the following considerations of the clinical data.

The number and percentages of cases that presented clinical signs of malnutrition are given for each age-group and locality in Tables II and IV respectively. The trends of the rates of incidence are illustrated in Figs. 1 and 2.

The effects of age and locality on the incidence of the clinical signs were determined. This was done by compiling the appropriate contingency-tables and applying the Chi-square test. The results for age and locality are summarized in Tables III and V respectively.

TABLE II. NUMBER OF RURAL AND URBAN VENDA IN EACH CLINICAL CATEGORY ACCORDING TO AGE

Category	Age-group	Rural	Urban
Traumatic cheilosis	**Below 20**	**2**	**0**
	20 - 29	**21**	**4**
	30 - 39	**7**	**6**
	40 - 49	**5**	**13**
	50 +	**2**	**5**
Gingivitis	**Below 20**	**1**	**0**
	20 - 29	**21**	**1**
	30 - 39	**11**	**11**
	40 - 49	**19**	**27**
	50 +	**7**	**19**
Xerosis	**Below 20**	**1**	**0**
	20 - 29	**9**	**0**
	30 - 39	**5**	**2**
	40 - 49	**7**	**1**
	50 +	**2**	**1**
Xerosis + follicular hyperkeratosis	**Below 20**	**0**	**0**
	20 - 29	**3**	**0**
	30 - 39	**3**	**0**
	40 - 49	**7**	**2**
	50 +	**4**	**1**
Follicular hyperkeratosis	**Below 20**	**1**	**5**
	20 - 29	**12**	**7**
	30 - 39	**8**	**12**
	40 - 49	**9**	**26**
	50 +	**2**	**15**
Pellagra skin lesions	**Below 20**	**1**	**0**
	20 - 29	**0**	**0**
	30 - 39	**0**	**0**
	40 - 49	**4**	**2**
	50 +	**1**	**1**

TABLE III. PROBABILITY LEVELS (P) PER CENT ASSOCIATED WITH CHI-SQUARE TEST FOR EFFECT OF AGE ON INCIDENCE OF CLINICAL CATEGORIES

	Locality	
Category	Rural	Urban
Cheilosis	**$P<0{\cdot}1$**	**$P<2{\cdot}0$**
Gingivitis	**$P<0{\cdot}1$**	**$P<0{\cdot}1$**
Skin conditions	**$P<1{\cdot}0$**	$P>5{\cdot}0$
Pellagra	**$P<0{\cdot}1$**	**$P<5{\cdot}0$**

Rural Subjects

Age was found to have had a significant effect on the incidence of cheilosis ($P<0{\cdot}1\%$), gingivitis ($P<0{\cdot}1\%$), skin conditions ($P<1{\cdot}0\%$) and pellagrous skin lesions ($P<0{\cdot}1\%$) (Table III).

Only one case of nutritional cheilosis occurred, therefore the significant difference in respect of cheilosis ($P<0{\cdot}1\%$) depended on the incidence of traumatic cheilosis alone. The incidence of traumatic cheilosis decreased with increasing age from 17% in the 20 - 29-year age-group to 8% in the group older than 50 years (Fig. 1).

The incidence of gingivitis increased significantly ($P<0{\cdot}1\%$) with age from 17% in the 20 - 29-year group to 35% in the 40 - 49-year group and then decreased to 27% in the oldest group (Fig. 1). Caries of up to 3 teeth occurred in 45 of the total number of subjects, and of 4 - 8 teeth in 4 cases. Up to 6 loose teeth occurred in 11 of the total number of rural test subjects.

TABLE IV. PERCENTAGE INCIDENCE OF CLINICAL CATEGORIES IN EACH 10-YEAR AGE-GROUP OF RURAL AND URBAN VENDA MALES

Category	Age-group	Rural	Urban
Traumatic cheilosis	Below 20	18	0
	20 - 29	17	11
	30 - 39	17	11
	40 - 49	9	13
	50 +	8	11
Gingivitis	Below 20	9	0
	20 - 29	17	3
	30 - 39	26	19
	40 - 49	35	26
	50 +	27	41
Xerosis	Below 20	9	0
	20 - 29	5	0
	30 - 39	12	4
	40 - 49	13	1
	50 +	8	2
Xerosis + follicular hyperkeratosis	Below 20	0	0
	20 - 29	2	0
	30 - 39	7	0
	40 - 49	13	2
	50 +	15	5
Follicular hyperkeratosis	Below 20	9	71
	20 - 29	10	20
	30 - 39	19	21
	40 - 49	16	25
	50 +	8	33
Pellagrous skin lesions	Below 20	9	0
	20 - 29	0	0
	30 - 39	0	0
	40 - 49	7	2
	50 +	4	2

TABLE V. PROBABILITY LEVELS (P) PER CENT OF RESULTS OF CHI-SQUARE TEST FOR EFFECT OF LOCALITY WITHIN EACH AGE-GROUP ON INCIDENCE OF CLINICAL SIGNS

	Age-group				
Category	Below 20	20 - 29	30 - 39	40 - 49	50 +
Cheilosis	P<5·0	—	—	P<1·0	—
Gingivitis	—	—	—	P<1·0	—
Skin conditions	—	P<5·0	P<5·0	P<1·0	P<5·0
Pellagra	—	—	—	P<1·0	—

Xerosis occurred in 5% of the 20 - 29-year group, and rose sharply to 12 and 13% in the 30 - 39- and the 40 - 49-year groups respectively and then declined to 8% in the oldest group (Fig. 2).

The incidence of follicular hyperkeratosis also rose sharply from 10% in the 20 - 29-year group to 19% in the 30 - 39-year group, and declined in the two older groups to 16 and 8% respectively. On the whole, the trend of

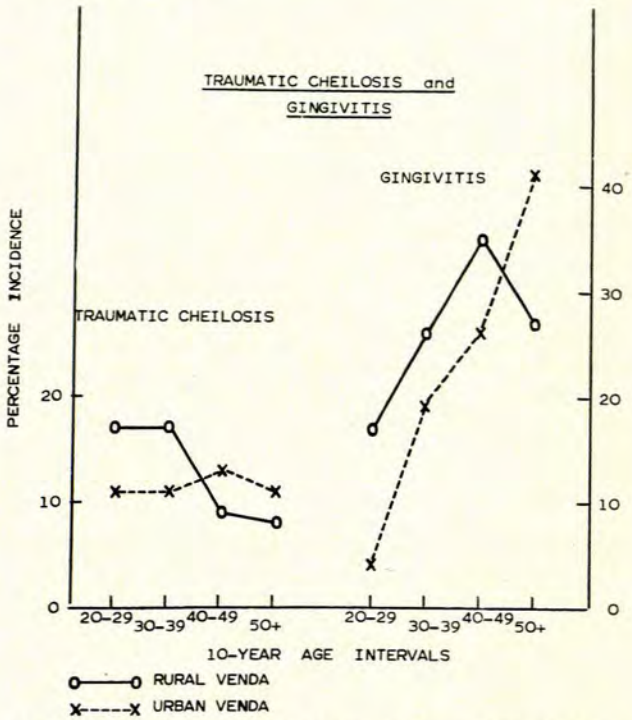

Fig. 1. The percentage incidence of traumatic cheilosis and gingivitis in each 10-year age-group in the rural and the urban areas.

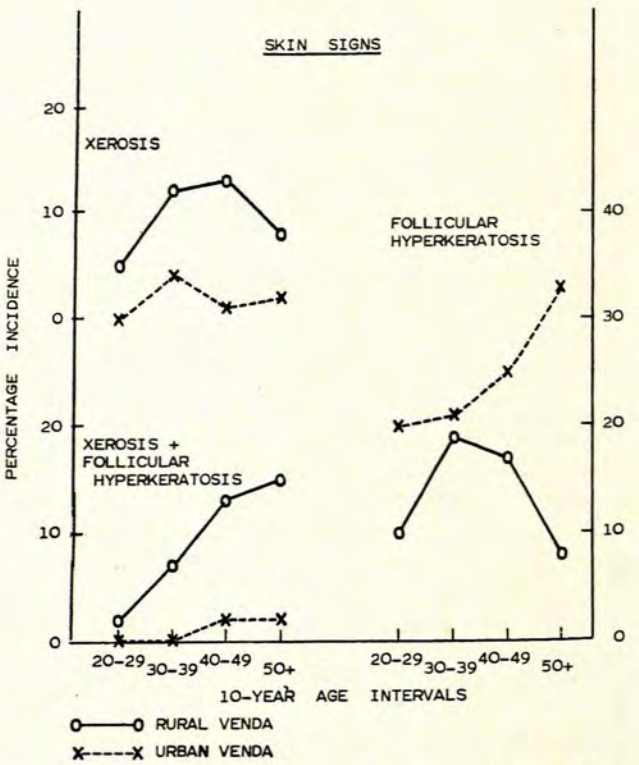

Fig. 2. The percentage incidence of xerosis, follicular hyperkeratosis and the combination thereof in each 10-year age-group in the rural and the urban areas.

incidence followed that of xerosis notwithstanding the fact that the two clinical conditions occurred in different subjects (Fig. 2).

The percentage of cases suffering simultaneously from xerosis and follicular hyperkeratosis increased progressively with age from 2% in the young group to 15% in the oldest group (Fig. 2). On the whole, the effect of age appeared to correspond with that found in the case of gingivitis.

Pellagrous skin lesions did not occur in the two younger groups, but were found in the two older groups, to the extent of 7 and 4% respectively.

Urban Subjects

Age was found to have had a significant effect on the incidence of cheilosis ($P<2{\cdot}0\%$), gingivitis ($P<1{\cdot}0\%$) and pellagrous skin lesions ($P<5{\cdot}0\%$). In the case of skin conditions the P-value was larger than 5% (Table III).

No cases of nutritional cheilosis were noted among the urban subjects. Traumatic cheilosis occurred in 11% of each of the two younger groups and the oldest group, and in 13% of the 40 - 49-year group (Fig. 1). Although the differences between the percentages were small, the effect of age was significant at the 2% level.

The incidence of gingivitis rose steeply and almost linearly with age, from 3% among the youngest to 19, 26 and 41% respectively in the older groups (Fig. 1). Caries of up to 3 teeth occurred in 40 and of 4 - 8 teeth in 6 of the total number of subjects. Up to 6 loose teeth occurred in 14 of the total number of urban test subjects.

Although no significant over-all effect of age at the 5% level was found on the incidence of the skin conditions (Table III), it is clear from Table IV and Fig. 2 that the percentages of cases of follicular hyperkeratosis were higher in the two older than in the two younger groups, namely 20 and 21% in the 20 - 29- and the 30 - 39-year groups respectively, and 25 and 33% in the 40 - 49-year group and in the subjects older than 50 years.

Between 2 and 4% of cases in all age-groups showed signs of xerosis and up to 4% had both xerosis and follicular hyperkeratosis (Fig. 2).

Pellagrous skin lesions occurred in 2% of each of the two older groups but were absent in the two younger groups. The effect of age was significant at the 5% level (Table III).

DISCUSSION

Age was shown to have had a significant effect on the incidence of the clinical signs, except in the case of the skin signs among the urban Venda (Table III), in which case the P-value was greater than 5%.

Judging by the percentage of incidence of traumatic cheilosis among the rural Venda, it is clear that the incidence decreased with age (Table IV). The signs occurred more often among the two younger than among the two older rural groups. In the case of the urban subjects the distribution was more or less even in respect of age. Only in the 40 - 49-year group was a significant difference in the incidence found between the rural and the urban groups (Table V), the city dwellers showing the higher incidence (Fig. 1).

Traumatic cheilosis is not associated with dietary deficiencies,[1] being caused by dehydration of the superficial epithelial layers of the lips as a result of exposure to adverse climatic conditions. Its presence may also be associated with the degree of melanin pigmentation. An explanation for the higher incidence of traumatic cheilosis among the younger than among the older rural Venda males (Fig. 1) may be the more active roaming nature of the younger and their working in the open, in comparison with the domestically more established older rural Venda, who lead a more restful sheltered life in or at their own or their friends' homes. Few of the younger rural Venda were employed indoors. This distinction between age-groups did not apply to the urban subjects, whose distribution between indoor and outdoor occupations was approximately the same for all ages. Probably as a result of this, the incidence of traumatic cheilosis did not vary greatly among the various age-groups. Thus it may be concluded that the difference in the incidence distribution of traumatic cheilosis among different age-groups between the rural and urban subjects was due to the degree of employment, the ambient physical conditions under which they work and the general way of life.

Only one case of nutritional cheilosis was found among the total number of test subjects examined. The main cause of this condition is considered to be a deficiency of riboflavin.[3-6] Thus, on clinical grounds it can be stated that the dietary intake of riboflavin was satisfactory in both localities. This conclusion agrees with that based on the excretion of riboflavin in the urine, only 5·5% of the rural and 1·2% of the urban subjects having had low excretions of riboflavin in the urine.

In general the incidence of diffuse gingivitis increased with age. The incidence of dental caries was low (Tables VI and VII) and was therefore not regarded as a cause of the gingivitis among the subjects of this survey. This contention is further supported by there having been no difference in the incidences of both carious and loose teeth between those subjects who had normal gums and those who had gingivitis (Tables VI and VII). The incidence of defective teeth was somewhat higher among the cases with normal gums.

Alternative causes of diffuse gingivitis could have been a deficiency of vitamin C in the diet,[3,7,8] a lack of effective oral hygiene, or the irritant effect of potent alcoholic drinks. Alcoholic drinks could also have contributed indirectly to a deficiency of vitamin C. Exactly to what extent potent drink could be blamed remains questionable since the information on the definite quantities could quite obviously not be obtained, home brewing being illegal. It appeared, however, that among the rural Venda a potent liquor, called '*tho-thotho*', is distilled from various highly undesirable fermented concoctions, and is consumed in larger quantities as age and leisure increase. Furthermore, the urban male also has a better opportunity to indulge in alcoholic beverages as he becomes older and financially better established. Both Bantu beer and

TABLE VI. NUMBER OF CASES IN EACH AGE-GROUP AND LOCALITY WITH CARIOUS AND LOOSE TEETH AMONG SUBJECTS WHO HAD NORMAL GUMS AND THOSE WHO HAD GINGIVITIS

	Age-groups and condition of gums									
	Below 20		20 - 29		30 - 39		40 - 49		50 +	
Description	Normal gums	Gingivitis	Normal gums	Gingivitis	Normal gums	Gingivitis	Normal gums	Gingivitis	Normal gums	Gingivitis
Rural cell sizes	**10**	**1**	**102**	**21**	**31**	**11**	**36**	**19**	**19**	**7**
Carious teeth:										
1 - 3 teeth	**1**	**0**	**12**	**1**	**3**	**1**	**18**	**4**	**5**	**1**
4 - 8 teeth	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**1**
Urban cell sizes	**7**	**0**	**34**	**1**	**46**	**11**	**76**	**27**	**27**	**19**
Carious teeth:										
1 - 3 teeth	**1**	**0**	**4**	**0**	**6**	**1**	**11**	**5**	**6**	**7**
4 - 8 teeth	**0**	**0**	**1**	**0**	**1**	**0**	**3**	**0**	**1**	**0**
Loose teeth:										
Rural										
1 - 4 teeth	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**4**	**2**	**0**
5 - 6 teeth	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Urban										
1 - 4 teeth	**0**	**0**	**0**	**0**	**1**	**1**	**6**	**3**	**2**	**1**
5 - 6 teeth	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

TABLE VII. PERCENTAGE OF CASES IN EACH AGE-GROUP AND LOCALITY WITH CARIOUS AND LOOSE TEETH AMONG SUBJECTS WHO HAD NORMAL GUMS AND THOSE WHO HAD GINGIVITIS

	Age-groups and condition of gums									
	Below 20		20 - 29		30 - 39		40 - 49		50 +	
Description	Normal gums	Gingivitis	Normal gums	Gingivitis	Normal gums	Gingivitis	Normal gums	Gingivitis	Normal gums	Gingivitis
Rural cell sizes	**10**	**1**	**102**	**21**	**31**	**11**	**36**	**19**	**19**	**7**
Carious teeth:										
1 - 3 teeth	**10**	**0**	**12**	**5**	**10**	**9**	**50**	**21**	**26**	**14**
4 - 8 teeth	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**0**	**5**	**14**
Urban cell sizes	**7**	**0**	**34**	**1**	**46**	**11**	**76**	**27**	**27**	**19**
Carious teeth:										
1 - 3 teeth	**14**	**0**	**12**	**0**	**13**	**9**	**15**	**19**	**22**	**37**
4 - 8 teeth	**0**	**0**	**3**	**0**	**2**	**0**	**4**	**0**	**4**	**0**
Loose teeth:										
Rural										
1 - 4 teeth	**0**	**0**	**0**	**0**	**0**	**18**	**8**	**21**	**11**	**0**
5 - 6 teeth	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Urban										
1 - 4 teeth	**0**	**0**	**0**	**0**	**2**	**9**	**8**	**11**	**7**	**5**
5 - 6 teeth	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**

'*mahewu*', which are the favourite Bantu beverages, are not good sources of vitamin C. These beverages are so filling that the consumers perhaps do not feel the need to take enough protective foods, such as those containing vitamin C.

Concerning the differences between corresponding rural and urban age-groups, it appeared that gingivitis was on the whole more prevalent among the rural than among the urban groups, except in the oldest group. However, only in the 40 - 49-year age-group was the difference significant ($P<1{\cdot}0\%$) (**Table V**).

Neglect of oral hygiene could not have played a major role in the aetiology of gingivitis, as is proved by the generally good condition of the teeth in both localities (Table VI). The South African Bantu usually take good care of their teeth by regularly rinsing the mouth with either plain or saline water after meals. Furthermore they consume virtually no sugar when in the rural environment

and, in comparison with the Whites, relatively little in the urban area. This low consumption deters the growth of cariogenic flora and the development of low-grade inflammatory conditions of the gums.

The blood serum levels of vitamin C of the same subjects were determined. Age had no effect on the serum vitamin C levels. Among the rural Venda 28% and among the urban Venda 41% had levels of below 0·4 mg/100 ml serum. According to the biochemical evaluation it was thus judged that more urban than rural Venda suffered from inadequate vitamin-C intakes.

Although the results of the clinical method of evaluation as to which community suffered more from a vitamin-C deficit, differ from the biochemical results, both methods of evaluation indicate that a vitamin-C deficit in up to 40% of the test subjects appeared to have existed. Furthermore, the clinical evaluation showed that the deficit increased with increasing age.

In general the incidence of xerosis, follicular hyperkeratosis and the combination of xerosis and follicular hyperkeratosis increased among the rural subjects, and only the incidence of follicular hyperkeratosis increased among the urban subjects with age (Fig. 2). The over-all increase in incidence with advancing age can also be attributed to the increased consumption of beer and *mahewu* and the consequent lower intake of vitamin A or carotene from animal and vegetable sources, owing to the 'filling' effect of these two beverages.

Xerosis may be caused by a deficiency of unsaturated fatty acids or of vitamin A or its precursor, carotene, or it may be caused by dry ambient conditions. The latter cause can, however, be ruled out for the purposes of this survey because of the living habits of the older people among whom the incidence of xerosis was on the whole higher than among the youngest group who lived more exposed lives.

The incidence of xerosis was considerably higher among the rural than among the urban subjects (Fig. 2). A similar picture is obtained of the incidence of xerosis and follicular hyperkeratosis occurring in the same subjects. In the case of follicular hyperkeratosis occurring singly in a subject, however, the picture is the reverse, the urban subjects showing a higher incidence of follicular hyperkeratosis in all age-groups (Table IV and Fig. 1).

According to the work of Rao[2] and in the opinion of the Expert Committee on Medical Assessment of Nutritional Status of the World Health Organization[3] vitamin-A deficiency can be a causal agent of both xerosis and follicular hyperkeratosis. By and large, other research workers have also postulated that follicular hyperkeratosis is usually the result of vitamin-A deficiency[9,10] or, more specifically, is related to faulty vitamin-A metabolism.[11,12] It appears that xerosis alone is an expression of a lesser degree of vitamin-A inadequacy than is follicular hyperkeratosis. Therefore, it can be assumed that a lesser degree of vitamin-A deficiency was prevalent among the rural and a more severe degree among the urban Venda, among whom the incidence of follicular hyperkeratosis was more pronounced than among the rural subjects. It may be that the coexistence of the two conditions in the same person indicates a vitamin-A status intermediate between xerosis and follicular hyperkeratosis.

An evaluation of serum vitamin-A levels in terms of the ICNND standards showed no signs of vitamin-A deficiency in either population group. In contrast, low carotene levels were found in 5% of the rural and in 70% of the urban group.

The dietary survey showed that the rural Venda partook daily of appreciable amounts of '*muroho*', a collective Venda name for a variety of indigenous green leafy foodstuffs, somewhat resembling spinach. The various types have a good carotene content. In contrast to the rural, the urban Venda hardly partook of *muroho*. This difference in the consumption of *muroho*, and thus of carotene, adequately accounts for the much higher incidence of low carotene serum levels among the urban than among the rural Venda, and thus of the more severe clinical signs of vitamin-A deficiency as evidenced by the occurrence of follicular hyperkeratosis among the urban Venda.

Preformed vitamin A is of animal origin. The dietary survey disclosed that the intakes of animal protein in both localities were on the whole low compared with western usage, and that the rural intakes were lower than the urban. The latter observation was corroborated by the serum albumin concentrations among the same subjects. Of the rural subjects 29·7% had either low or deficient serum albumin levels, and 2·4% of the urban subjects had low levels.

The presence or the absence of clinical signs which are normally attributed to vitamin A deficiency also depends on the levels of intake of high quality protein.[13,14] It has been shown that hydrolysis of the ingested vitamin-A esters is reduced during protein deficit. That this is in a large measure due to the reduced activity of the pancreatic vitamin-A esterhydrolysing enzyme was confirmed by *in vitro* experiments.[13] Furthermore, Arroyave *et al.* stated that the conversion of carotene to vitamin A is also affected by balanced protein intake.[14]

It therefore appears that there is no actual conflict between the results of the biochemical and the clinical methods of evaluating the vitamin-A status. The apparent discrepancy appears to arise from the fact that the biochemical verdict was based on the consideration of the total vitamin-A serum levels only.

Considering the evidence quoted from the literature,[12-14] as well as the clinical and biochemical findings (on protein status), it is concluded that the subjects showed signs which could be attributed either to low carotene intakes or to faulty metabolism of vitamin A owing to deficient intakes of balanced protein.

In the rural area the intake of vitamin A from animal origin was low, as was that of balanced protein, while the carotene intake was satisfactory. Thus it appears that the clinical signs of vitamin-A deficiency which occurred among the rural Venda were due to faulty metabolism of vitamin A and carotene, presumably because of a low and even deficient intake of balanced protein. Among the urban Venda it appeared that the clinical signs of vitamin-A deficiency were due to a carotene deficit in the diet.

Overt pellagrous skin lesions occurred in both localities in the two older groups only, viz. 5 cases from 81 rural (i.e. 7%) and 3 cases from 149 urban males (i.e. 2%) of the age of 40 years and above (Table II). When these figures are related to the total number of subjects in each area, it is clear that 2·5% of the rural and 1·2% of the urban subjects suffered from pellagra. The difference in incidence between the two areas, although small, was significant (Table V).

According to the biochemical evaluation of the nicotinic acid status of the same subjects, 60% of the rural and 47% of the urban groups could be considered to be in a sub-optimal range of nicotinic acid nutrition. It should be noted that a clinical examination detects only the overt cases, whereas the biochemical method of evaluation detects the preclinical cases as well.

It should also be noted that none of the 8 cases of pellagra in the total sample showed signs of nutritional cheilosis. This finding is in contrast to the view of Goldsmith,[15] that cheilosis is often associated with pellagra when the riboflavin intake has been adequate.

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