DIETARY EVALUATION

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SUMMARY

Basic results regarding food and nutrient intakes of 266 rural and 241 urban adult Venda males, as determined by quantitative dietary surveys, are presented.

Marked differences between the dietary patterns of the rural and urban communities were observed. Rural subjects, on the whole, subsisted mainly on a predominantly maize diet, supplemented by green leafy vegetables, peanuts and, to a smaller extent, by insects. The diets were practically devoid of animal products, fruit and sugar. Urban subjects consumed a semi-western diet. Part of the maize in the diet had been replaced by other cereal products, especially white bread. Meat, especially beef, was eaten at least once a day by the majority of subjects. Intake of vegetables was limited to a watery stew of tomatoes and onions in most cases. Consumption of fruit was variable, but, on the whole, extremely low. Traditional beverages such as Bantu beer and cereal gruel have been partly replaced by soft drinks and tea, coffee, cocoa or Milo served with milk and sugar.

The difference between the traditional and the semi-western dietary patterns is portrayed by the contrasting results obtained in respect of nutrient intakes. Significant differences are shown for every nutrient for almost all ages.

In comparison, urban subjects had remarkably higher intakes of animal protein, animal fat, preformed vitamin A and of sugar, while their intakes of calcium, carotene and ascorbic acid were far below the intake levels of their rural counterparts.

On the whole, it may be assumed that the nutrition status of the urban Venda was superior to that of the rural group.

As for the rural Venda, lack of animal protein, imbalance between preformed vitamin A and carotene, possible unavailability of nicotine acid and low intakes of ascorbic acid, are factors which might cause concern.

In the case of the urban Venda, low intakes of calcium, carotene and ascorbic acid and also the possible unavailability of nicotinic acid, may be noteworthy.

Quantitative dietary surveys were conducted on 266 rural and 241 urban adult Venda males. The 'modified dietary history' (MDH) method[1] was employed for both surveys. Adult Venda males, recruited from the rural community, acted as field-workers for both the rural and the urban surveys. Before the commencement of the surveys these field-workers received the necessary training and were subsequently controlled, supervised and assisted by the dietitians responsible for the execution of the dietary surveys, throughout the course of the study. Qualitative as well as quantitative dietary information was collected in order to obtain a general picture of the habitual daily food consumption of the test subjects for that particular season of the year.

The amounts of the various foods habitually consumed during the course of a 24-hour period were determined by weighing. Where necessary, the nutrient contents of the different foods consumed were determined by chemical analyses of food samples collected from the households concerned. However, standard food tables were used for certain food items.

The mean daily nutrient intake of each individual subject was subsequently calculated with the aid of a 360/65 IBM computer. Nutrient intakes were also compared with the National Research Council's recommended dietary allowances (RDA) (Table I).[2]

The statistical test of Steffens,[3] which is based on a comparison of two regression lines (nutrient on age), was used in order to determine an age interval where the nutrient intake of rural and urban subjects differed significantly. This particular test was chosen because of the unequal age distribution of the two samples. All tests were carried out at a 5% level of significance.

In the present report only basic results regarding the food and nutrient intakes of the rural and urban samples are being presented.

RESULTS AND DISCUSSION

Food Intake

Marked differences were observed regarding the mode of living and consequently the habitual dietary patterns

TABLE I. RECOMMENDED DAILY DIETARY ALLOWANCES* (RDA)

Age-group (years)	Calories (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Vitamin A (IU)	Thiamine (mg)	Ribo-flavin (mg)	Nicotinic acid (mg)	Ascorbic acid (mg)
<20	2 800	60·0	800	10	5 000	1·400	1·60	18·00	60
20 - 29	2 800	62·5	800	10	5 000	1·400	1·65	18·00	60
30 - 39	2 730	65·0	800	10	5 000	1·365	1·70	17·65	60
40 - 49	2 610	65·0	800	10	5 000	1·306	1·70	16·85	60
⩾50	2 475	65·0	800	10	5 000	1·238	1·70	15·12	60

* Values for age-groups calculated by linear interpolation.

followd by urban subjects as compared with the rural group.

Rural subjects. These subjects consumed a simple, traditional diet of two main meals per day, one eaten at midday and the other after sunset. Each meal consisted of two different food items, namely a cereal food and a relish, served into and eaten directly from two separate containers. Maize-meal porridge, prepared in various ways, constituted the major food item for both meals and was consumed in large quantities (up to 3 883 g per person per day). The porridge was cooked in either clay or iron pots with no salt or fat added. All subjects preferred to eat porridge made from home-pounded maize, but as a result of the drought crops were limited and many families were therefore compelled to supplement their own produce with commercial maize-meal. Consequently, 63% of the subjects consumed home-pounded maize (the mean daily intake for the total sample being 961 g of porridge) while 'Special Sifted Granulated' maize-meal was used by 55% of the subjects (mean intake 790 g of porridge).

Occasionally, porridge would be replaced by corn on the cob (either boiled or roasted on coals) or by a special Venda delicacy, *'tshidzimba'*, which is normally prepared from samp and peanuts, with Njugo beans sometimes added as well. Bread was consumed by only 2% of the rural subjects (mean intake 3 g) and did not replace porridge at a main meal but was taken as a snack during the morning.

The second most important food item on the rural menu was contributed by the vegetable group, as the majority of the subjects (93%) consumed a vegetable dish as relish at one or both meals (mean intake 586 g). Fresh as well as dehydrated green leafy vegetables from cultivated and wild varieties were used extensively. The leaves, which were usually cooked in water and relatively large amounts of table salt, were either eaten as such or mixed with ground peanuts. Occasionally, roasted pumpkin seeds, marula nuts or sesame seeds would be incorporated into the vegetable dish instead of peanuts. Potatoes, sweet potatoes and pumpkin were less frequently consumed by a small percentage of subjects.

Although meat was regarded as the favourite delicacy, intake of meat by the rural group was almost negligible. Only 10% of the subjects consumed meat of any kind during the survey period (mean intake 33 g), while 23% of the subjects ate beetles and mopanie worms as relish with their porridge (mean intake 63 g). Dried beans, cowpeas and peanuts (boiled or roasted) were eaten by 9% of the subjects (mean intake 35 g).

Traditional beverages were consumed extensively between meals by all subjects. Home-made Bantu beer (*'Halwa'*) was taken in large amounts (mean intake 2 374 g) by 56% of the subjects at any time through the day, while the non-beerdrinkers (31%) consumed a thin cereal gruel (*'Mabundu Masekene'*). Some 7% of the subjects also consumed a thick cereal gruel (*'Mabundu Madenya'*). Only 3% of the subjects drank tea with sugar (mean intake of sugar <1 g), while 1% also used sweetened condensed milk in their tea (mean intake 1 g). Fresh milk was not used by any of the subjects during the survey period.

Urban subjects. In contrast to the rural group, urban subjects consumed a semi-western diet consisting of 2 - 3 meals per day, with beverages and/or snacks taken between meals. Depending upon circumstances of employment, meals were eaten at home and/or at work. Most of the employers supplied beverages (mainly tea with milk and sugar) and many also served meals to their employees.

Maize-meal porridge, prepared mainly from either 'Special Sifted Granulated' maize-meal or bakers' cones, constituted the basis of the daily diet and was consumed by all urban subjects at least once per day. The mean daily intake of porridge was 1 390 g, while individual intakes varied from 198 to 3 260 g/day. Samp, mealie-rice or rice was occasionally taken as substitute for porridge by 7% of the subjects during weekdays, but rice was frequently eaten during weekends.

Many subjects (81%) ate bread as a snack or as part of their early-morning or midday meals (mean intake 303 g). White bread, buns and scones were far more popular than either brown or wholewheat bread. A small number of subjects (11%) habitually ate butter with their bread, while peanut-butter or cheese was used by 2%, and 1% ate jam.

The most striking difference between the rural and urban diet, however, was the high intake of meat by the urban subjects. Meat was consumed at least once daily, but in many instances 2 - 3 times per day by 98% of the urban subjects. Beef, either roasted or stewed in water, was eaten with the porridge by 97% of the urban subjects, while 10% also consumed other kinds of meat, e.g. mutton, pork and chicken.

Vegetables, which constituted a minor part of the daily diet, were mainly taken in the form of a thin gravy (soup) by 95% of the urban subjects (mean intake 156 g). In most cases (66%) this gravy consisted of small amounts of tomatoes and onions which were stewed with the meat. Potatoes and other vegetables were occasionally added to the gravy, but potatoes as such were consumed by 24% of the subjects only (mean intake 27 g). Urban subjects also ate negligible amounts of green and yellow vegetables (mean intakes were 18 g and 2 g respectively) in contrast to the high intake of green leafy vegetables by the rural group.

Traditional beverages, such as Bantu beer and *'Mabundu'* (cereal gruel) were consumed between meals by 22% and 12% of the subjects respectively with mean intakes of 395 g for Bantu beer and 149 g for *'Mabundu'*. The lower intake of these beverages by the urban group may be due to the fact that the urbanized Venda had acquired the habit of drinking European-type beverages such as tea, coffee, Milo and soft drinks. However, the above figures may not give a true indication of the actual consumption of Bantu beer. It is believed that the majority of subjects did in fact consume larger quantities of beer as well as other types of liquor, especially during weekends.

The habitual consumption of tea and similar beverages naturally led to a relatively higher intake of sugar and milk as compared with the rural group. Sugar was used

daily by 92% of the subjects (mean intake 52 g) and 89% consumed milk, the mean intake for fresh, whole milk being 122 g and that of sweetened condensed milk 8 g.

Intake of fruit was negligible in both communities. Only 2% of the subjects from each sample habitually consumed fruit as part of their daily diet. The mean daily intake for this item was therefore extremely low, e.g. 16 g for the rural group and 4 g in the case of urban subjects.

Nutrient Intake

The mean daily nutriet intakes of both the rural and urban subjects are presented in Tables II - X. Mean values, standard deviations, minimum and maximum intakes are given for each separate age-group as well as for the total sample surveyed in each locality. In Table XI the mean intakes of calories and 8 nutrients are expressed as percentages of the recommended dietary allowances (RDA), while Table XII shows the percentages of subjects who may be considered to have had poor (≤50% of RDA), fair (51 - 70% of RDA) and satisfactory (> 70% of RDA) intakes of the nutrients concerned. The results of the statistical tests are presented in Table XIII.

Calories. A significant difference in calorie intake was found between rural and urban subjects of 37 years and older (Table XIII). The mean calorie intakes of both rural and urban subjects are well above the RDA for the moderately active reference man. The mean intake of 3 976 kcal (151% of RDA) of urban subjects, however, is slightly higher than that of rural subjects who had an average of 3 664 kcal (135% of RDA). Urban intakes also show a definite increase with progressing age, ranging from 104% of RDA for the youngest to 165% of RDA for the oldest group. In contrast, rural intakes decrease with progressing age, ranging from 153% of RDA for the youngest to 137% of RDA for the oldest group (Tables II and XI).

Table XII shows that all urban subjects had satisfactory intakes of calories, while of the rural subjects 1% had poor and 6% fair intakes. In spite of high calorie intakes, rural subjects appeared to be thin, while their urban counterparts were study and physically better developed. Urban subjects were also considered to be physically more active. The difference in activity patterns may, therefore, partially account for the difference in muscularity between the two groups. Although heights did not differ appreciably, rural body-weights were significantly lower than urban weights. A significant difference was also found for the percentage body fat; urban values being much higher and increasing with age. The increase in percentage body fat with progressing age in urban subjects also corresponds with the increase in calorie intake with progressing age.

Apart from the food energy supplied by the diet, the difference between rural and urban diets regarding protein quality is of major importance in this connection (Table III). In addition, rural subjects derived their food energy from a predominantly maize diet which means that a large proportion of the calories supplied might possibly not have been utilized effectively. It was found that the total weight of food consumed, as well as the moisture, fibre and alcohol content of rural and urban diets, differed significantly (Table XIII) for all ages. The total weight of food consumed by the rural group (mean 5 588 g) was much higher than that consumed by urban subjects (mean 3 015 g) for all age-groups (Table II). The cereal group made the highest contribution towards the total weight of food consumed by both samples, namely 87% in the case of the rural group and 75% for the urban. The rural diet also had a much higher moisture and fibre content as compared with the urban (Table II), mainly as a result of the higher consumption of Bantu beer, coarse maize-meal porridge and green leafy vegetables. Table II also shows a remarkably high alcohol intake by rural subjects (mean 52·8 g) in comparison with that of the urban group (mean 12·3 g), but intakes tend to increase with increasing age for both groups. The moisture and alcohol contents

TABLE II. TOTAL WEIGHT OF FOOD INGESTED, AMOUNT OF MOISTURE AND FIBRE IN DIET, AMOUNT OF ALCOHOL INGESTED AND TOTAL CALORIE INTAKE

Age-group (yrs)	Locality	Total weight of food (g)			Moisture (g)			Moisture % of total weight of food		Fibre, (g)			Fibre % of total weight of food		Alcohol (g)			Calories (kcal)		
		Mean	SD	Range*	Mean	SD	Range*	Mean	Range*	Mean	SD	Range*	Mean	Range*	Mean	SD	Range*	Mean	SD	Range*
<20	Rural	5 458	2 084	6 067	4 480	1 782	5 462	82·1	19·4	36·9	24·9	77·0	0·68	1·12	33·1	43·8	134·7	4 292	2 394	8 051
	Urban	1 947	611	1 742	1 329	488	1 486	68·3	20·7	4·5	2·0	5·1	0·23	0·31	0·0	0·0	0·0	2 908	795	2 055
20 - 29	Rural	5 358	2 464	10 403	4 517	2 246	9 211	84·3	20·6	26·9	15·9	104·4	0·50	1·23	39·5	56·8	207·7	3 676	1 578	7 368
	Urban	2 600	1 266	6 076	1 815	1 086	5 121	69·8	33·1	5·7	3·7	17·3	0·22	0·50	9·3	27·7	106·2	3 668	1 216	4 920
30 - 39	Rural	6 352	2 306	8 448	5 530	2 186	7 884	87·1	20·4	23·9	9·2	36·1	0·38	1·18	74·4	58·1	202·1	3 843	1 058	4 603
	Urban	2 992	1 106	5 257	2 137	1 054	5 165	71·4	34·6	5·6	2·0	9·9	0·19	0·41	11·6	34·4	185·0	4 023	837	3 664
40 - 49	Rural	5 658	2 159	9 186	4 889	2 016	8 460	86·4	19·4	21·3	12·5	73·9	0·38	1·19	61·9	54·4	179·7	3 530	1 220	6 459
	Urban	3 156	1 365	8 157	2 289	1 213	7 312	72·5	30·8	5·9	2·9	20·6	0·19	0·38	13·2	27·8	163·8	4 083	1 073	4 778
≥50	Rural	5 333	2 299	8 234	4 610	2 172	7 829	86·5	17·1	19·4	9·6	38·2	0·36	0·88	67·4	56·7	219·9	3 382	1 092	3 901
	Urban	3 217	1 228	5 133	2 352	1 117	4 522	73·1	32·6	5·7	2·5	11·0	0·18	0·27	15·5	29·8	148 0	4 085	1 011	3 975
All age-groups	Rural	5 588	2 358	11 028	4 773	2 183	9 684	85·4	24·0	24·8	14·5	107·8	0·44	1·38	52·8	57·6	219·9	3 664	1 423	8 992
	Urban	3 015	1 272	8 442	2 170	1 141	7 564	72·0	36·7	5·7	2·8	20·6	0·19	0·52	12·3	29·4	185·0	3 976	1 044	5 152

* Range = maximum — minimum values.

of the diets give an indication of the large quantities of Bantu beer consumed by both groups, but especially so in the case of rural subjects. However, the actual alcohol intakes of urban subjects are likely to be considerably higher than the values presented here, as it was much more difficult to obtain true information regarding liquor consumption in the urban community.

Protein. Total protein intakes of both groups are higher than the RDA (Tables III and XI), the mean values being 117·7 g (185% of RDA) and 126·0 g (195% of RDA) for the rural and urban groups respectively. In the case of rural subjects, values decrease with increasing age (252 - 165% of RDA), while urban intakes increase with progressing age (156 - 201% of RDA). Table XII shows that all urban and practically all rural subjects had satisfactory intakes of total protein. While the total protein intakes of rural and urban subjects differed significantly only for 43 years and older, both the animal and vegetable protein intakes differed significantly for all ages (Table XIII).

The major differences between the two groups, therefore, appear to be the proportions of animal and vegetable proteins supplied by the diet. From Table II it is evident that urban subjects had a higher animal protein intake (mean 66·4 g) than rural subjects (mean 17·7 g). The mean rural intake of vegetable protein was therefore much higher (100·0 g) than the value found for urban subjects (59·6 g). Urban values for both animal and vegetable protein increase with progressing age. Animal protein values for the rural group show a very slight increase, while vegetable protein intakes decrease with increasing age.

The obvious difference between the two groups regarding animal protein intake might therefore be considered to be an important factor concerning the difference in muscular development between rural and urban subjects. The biochemical data also indicated that the protein nutrition status of the urban group was substantially superior to that of the rural group.

Fat. A significant difference between rural and urban intakes was found in respect of animal and total fat for all ages, while vegetable fat intakes differed significantly up to the age of 50 years (Table XIII). Intakes of total fat for all age-groups of urban subjects were higher (mean 126·7 g) than those of rural subjects (mean 55·0 g). With urban subjects, intakes again tend to increase with progressing age, while a decrease is found for rural subjects (Table IV).

The main difference between the two groups here again lies in the proportions of animal and vegetable fats. All age-groups of urban subjects had higher mean intakes of animal fat (mean 106·4 g) than rural subjects (mean 18·7 g). On the other hand, rural values for vegetable fat were consistently higher (mean 36·3 g) than urban values (mean 20·3 g). Urban intakes of animal fat tend to increase with increasing age, while the reverse is found for the rural group.

The biochemical findings again correspond with the dietary findings; the differences in lipid levels between the two groups, although not significant, are indicative of higher intakes by urban subjects.

Carbohydrates. Total carbohydrate intakes of rural and urban subjects differed significantly up to the age of 32 years (Table XIII), the mean intake (Table V) being slightly higher for rural (583·3 g) than for urban subjects (559·1 g).

The major difference between rural and urban subjects in respect of carbohydrate is found in the proportion of sugar in the diet, and a significant difference in intake was found for all ages (Table XIII). The rural diet contains virtually no sugar (mean 0·4 g) in contrast to a mean intake of 62·0 g by urban subjects. (The term 'sugar' applies to sucrose taken as such or as an ingredient of foods and beverages).

Values for starch intake (including simple sugars present in natural foods) differed significantly up to the age of 45 years (Table XIII) and are higher for rural (mean 582·9 g) than for urban subjects (mean 497·1 g). Starch intakes again tend to increase with progressing age for urban subjects, while the reverse is found for the rural group.

TABLE III. INTAKE OF PROTEIN

Age-group (years)	Locality	Animal (g)				Vegetable (g)				Total (g)			
		Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
<20	Urban	28.3	52·0	0·0	129·2	123·0	73·6	57·9	297·8	151·2	110·2	57·9	420·9
	Rural	54·4	22·5	27·2	92·2	39·5	11·7	19·7	57·1	93·9	27·9	65·8	139·2
20 - 29	Urban	16·3	36·7	0·0	299·3	103·4	48·2	35·6	326·2	119·7	62·5	39·3	392·6
	Rural	60·9	34·6	14·4	144·6	55·6	19·9	30·4	110·6	116·4	44·6	55·4	221·6
30 - 39	Urban	14·3	26·2	0·0	103·2	99·8	30·7	35·4	165·5	114·2	35·5	42·5	196·1
	Rural	67·6	31·9	6·2	159·7	60·1	15·0	28·5	110·5	127·7	34·8	62·0	216·2
40 - 49	Urban	21·5	44·6	0·0	259·0	94·0	41·8	22·1	328·7	115·5	71·1	22·1	434·2
	Rural	67·8	29·7	13·9	153·8	60·6	21·6	16·6	133·0	128·4	37·6	53·4	221·0
⩾50	Urban	18·3	35·3	0·0	117·4	89·0	28·3	48·7	162·3	107·3	41·0	48·7	180·9
	Rural	67·9	34·2	0·0	152·2	63·0	19·3	26·8	126·1	130·9	40·0	61·5	229·8
All age-groups	Rural	17·7	37·3	0·0	299·3	100·0	43·9	22·1	328·7	117·7	61·1	22·1	434·2
	Urban	66·4	31·6	0·0	159·7	59·6	19·6	16·6	133·0	126·0	38·6	53·4	229·8

TABLE IV. INTAKE OF FAT

Age-group (years)	Locality	Animal (g)				Vegetable (g)				Total (g)			
		Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
<20	Rural	35·6	69·8	0·0	171·6	60·7	92·3	14·6	319·5	96·3	146·7	14·6	483·1
	Urban	84·9	36·4	44·0	157·2	15·5	10·6	7·5	38·2	100·4	41·6	53·0	173·0
20 - 29	Rural	18·2	46·4	0·0	397·6	40·1	41·1	6·4	214·9	58·3	66·5	6·7	422·5
	Urban	96·0	58·9	23·4	241·3	19·7	9·3	6·9	45·0	115·7	60·7	47·3	263·3
30 - 39	Rural	18·9	40·3	0·0	173·0	32·4	18·5	6·7	116·4	51·4	43·6	6·7	194·0
	Urban	105·8	55·2	10·4	250·0	23·1	11·2	10·6	66·6	128·9	55·6	29·9	271·0
40 - 49	Rural	16·6	33·6	0·0	140·2	31·2	23·8	5·9	137·8	47·8	46·9	5·9	219·1
	Urban	110·4	50·4	2·8	256·0	19·8	9·4	2·9	55·1	130·2	52·7	11·9	276·5
⩾50	Rural	18·8	42·8	0·0	155·9	27·1	12·3	6·9	48·5	45·9	43·1	6·9	178·9
	Urban	109·8	56·5	0·0	253·9	18·9	7·4	5·7	38·7	128·6	56·0	16·2	279·7
All age-groups	Rural	18·7	43·5	0·0	397·6	36·3	36·4	5·9	319·5	55·0	62·3	5·9	483·1
	Urban	106·4	53·6	0·0	256·0	20·3	9·6	2·9	66·6	126·7	54·9	11·9	279·7

TABLE V. INTAKE OF CARBOHYDRATE

Age-group	Locality	Sugar * (g)				Starch † (g)				Total (g)			
		Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
<20	Rural	0·0	0·0	0·0	0·0	646·5	278·1	296·3	1 198.2	646·5	278·1	296·3	1 198·2
	Urban	56·8	28·8	25·5	111·3	348·6	98·0	204·7	459·1	405·4	110·4	230·2	509·8
20 - 29	Rural	0·3	2·3	0·0	23·9	599·6	213·9	220·1	1 208·6	599·9	213·7	220·1	1 208·6
	Urban	62·9	37·9	0·0	153·9	458·9	138·2	262·8	814·6	521·8	147·8	338·0	944.2
30 - 39	Rural	0·3	1·8	0·0	11·9	601.1	154·1	282·8	990·3	601·3	154·1	282·8	990·3
	Urban	64·9	39·5	0·0	185·1	500·4	114·6	270·4	748·5	565·3	127·2	286·6	884·4
40 - 49	Rural	0·0	0·0	0·0	0·0	552·9	168·7	115·0	1 179·1	552·9	168·7	115·0	1 179·1
	Urban	65·8	45·2	0·0	206·3	508·1	153·7	188·0	1 000·9	573·9	161·2	249·3	1 038·6
⩾50	Rural	2·0	5·5	0·0	23·9	517·3	148·4	293·2	889·6	519·3	147·7	293·2	889·6
	Urban	50·1	34·5	0·0	132·3	521·0	147.6	255·3	942·1	571·0	149·2	255·3	942·1
All age-groups	Rural	0·4	2·6	0·0	23·9	582·9	193·5	115·0	1 208·6	583·3	193·3	115·0	1 208·6
	Urban	62·0	40·8	0·0	206·3	497·1	143·2	188·0	1 000·9	559·1	150·6	230·2	1 038·6

* Sugar denotes added surcrose taken as such or as ingredient of foods and beverages.
† Starch as well as simple sugars present in natural foods.

Calcium. There is a significant difference between the two groups with regard to calcium intake for all ages (Table XIII). From Table VI it is evident that intakes of all rural age-groups (mean 1 614 mg) were higher than urban intakes (mean 421 mg). In comparison with the RDA of 800 mg for all age-groups, the mean intake of rural subjects constitutes 202% of the RDA, while the mean intake of urban subjects equals only 53% of the RDA (Table XI). From Table XII it is clear that the majority of rural subjects (86%) had satisfactory intakes, while more than half of the urban subjects (65%) had poor intakes and a further 15% had only fair intakes.

As for the exceptionally high values for the rural group, it may be pointed out that ± 80% of the dietary calcium was derived from green leafy vegetables, which means that a large proportion of this calcium might be unavailable to the human body. The rural diet was practically devoid of milk, while almost all urban diets contained milk in some form. Therefore, the smaller amount of calcium in the urban diet might possibly have been utilized more effectively.

Phosphorus. A significant difference was found between the phosphorus intakes for all ages (Table XIII); the mean intakes (Table VI) in both localities may, however, be considered as being more than adequate. The higher intake of rural subjects (mean 2 315 mg) than that of urban subjects (mean 1 514 mg) was mainly derived from cereal products (74%) where a large proportion of the phosphorus might have been in a bound form. Urban subjects, on the other hand, derived 23% of their phosphorus from the meat group, and a further 9% from the milk group.

Iron. Iron intakes differed significantly for all ages (Table XIII). In comparison with the RDA of 10 mg, intakes of both urban (mean 34·7 mg) and rural (mean 446·6 mg) subjects were exceptionally high, the latter being unrealistic indeed (Table VI).

TABLE VI. INTAKE OF CALCIUM, PHOSPHORUS AND IRON

Age-group (years)	Locality	Calcium (mg)				Phosphorus (mg)				Iron (mg)			
		Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
<20	Rural	2 102·0	1 375·0	790·3	4 763·6	2 736·1	1 391·0	1 274·6	5 664·5	363·7	205·8	140·1	725·5
	Urban	236·0	110·6	103·9	401·9	1 081·0	407·1	555·9	1 808·9	19·6	7·2	11·0	29·6
20 - 29	Rural	1 692·8	1 239·2	211·8	6 499·8	2 318·3	1 161·3	620·3	8 246·9	368·3	260·0	42·0	1 479·2
	Urban	428·0	297·2	111·6	1 238·6	1 407·5	607·0	592·9	2 788·2	22·1	10·0	8·5	53·1
30 - 39	Rural	1 512·2	1 032·3	292·3	4 719·2	2 437·8	839·2	888·6	4 605·9	528·2	355·8	44·4	1 645·1
	Urban	447·6	287·6	84·7	1 367·0	1 532·9	531·0	831·1	4 347·0	28·0	20·3	10·8	135·8
40 - 49	Rural	1 492·5	1 198·2	281·2	6 550·7	2 248·5	1 293·3	418·8	9 122·2	518·7	359·2	51·4	1 340·4
	Urban	407·7	251·5	49·5	1 214·0	1 582·9	808·9	473·5	5 607·3	39·9	43·9	8·1	273·8
⩾50	Rural	1 491·6	1 138·6	262·3	5 349·2	2 097·2	780·4	574·7	3 561·3	553·6	350·1	94·1	1 420·1
	Urban	438·9	359·3	45·0	1 757·2	1 487·5	630·9	589·8	4 382·0	43·4	39·9	9·9	153·0
All age-groups	Rural	1 614·2	1 191·1	211·8	6 550·7	2 315·1	1 113·8	418·8	9 122·2	446·6	317·0	42·0	1 645·1
	Urban	420·8	286·9	45·0	1 757·2	1 513·9	683·6	473·5	5 607·3	34·7	35·3	8·1	273·8

Table XII shows that all subjects in both localities had satisfactory intakes, but in fact most, if not all, had excessive intakes. The high values may be associated with contamination through the use of iron cooking utensils. In any case, according to the haematological data, no iron deficiency was found.

Sodium and potassium. A significant difference in sodium intake was found for the age of 22 years and over (Table XIII). Table VII indicates a slightly higher intake by urban subjects (mean 4 444 mg) than by rural subjects (mean 3 540 mg). Rural intakes tend to decrease with increasing age, the main source of sodium being table salt added to vegetable dishes during the cooking process. Apart from added table salt, the urban diet contains more animal products with a high sodium content than the rural diet.

Potassium intakes, which differed significantly for all ages, are lower for the urban group (mean 2 554 mg) than for the rural subjects (mean 5 331 mg) and may be associated with the lower consumption of vegetables by urban subjects.

Vitamin A. The mean intake of total vitamin A (Table VIII) by the rural group (6 619 IU) exceeds the RDA of 5 000 IU. All the rural age-groups had mean intakes of more than 100% of the RDA, the average being 132% (Table XI).

Table XII, however, shows that only 60% of the rural subjects had satisfactory intakes. Twenty-nine per cent had poor intakes, while 11% were grouped as 'fair'. It is thus evident that some individuals had exceptionally high intakes of this vitamin.

Table VIII also shows that the rural diet contained virtually no preformed vitamin A. Therefore, almost all the vitamin A had been derived from carotene, which was mainly obtained from the vegetable group. Taking into account that the availability of carotene may be low and variable, especially in diets with a low fat content, a certain degree of vitamin A deficiency might be expected. According to the biochemical data, 5% of the rural group had low carotene levels, while the clinical data showed skin lesions which might be related to a deficit

TABLE VII. INTAKE OF SODIUM AND POTASSIUM

Age-group (years)	Locality	Sodium (mg)				Potassium (mg)			
		Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
<20	Rural	5 880·5	3 588·6	1 602·7	12 389·9	7 131·4	3 939·8	2 395·9	15 167.1
	Urban	3 946·2	1 475·2	2 164·3	6 571·7	1 899·1	592·7	925·9	2 528·0
20 - 29	Rural	3 744·7	2 394·4	693·4	12 264·0	5 484·7	3 153·1	1 068·0	20 059·8
	Urban	4 682·4	1 701·3	769·7	7 996·3	2 497·4	1 155·7	976.6	5 631.8
30 - 39	Rural	3 308·8	1 880·6	955·4	10 873·3	5 203·0	1 974·7	2 146·2	10 345·7
	Urban	4 562·1	1 510·3	1 702·8	9 352·6	2 627·9	764·0	1 112·0	4 178·5
40 - 49	Rural	3 116·7	2 295·4	543·3	12 346·3	5 163·2	3 409·4	1 157·8	23 528·5
	Urban	4 459·9	1 614·8	1 226·5	8 069·1	2 601·5	1 065·0	758·4	6 584·0
⩾50	Rural	2 998·5	1 389·0	640·0	6 245·5	4 577·2	1 953·5	1 344·6	9 029·6
	Urban	4 159·0	1 269·3	1 982·7	7 713·7	2 500·2	885·6	1 116·0	4 994·9
All age-groups	Rural	3 539·6	2 284·6	543·9	12 389·9	5 331·2	2 975·1	1 068·0	23 528·5
	Urban	4 444·3	1 538·7	769·7	9 352·6	2 553·7	972·9	758·4	6 584·0

in metabolically active vitamin A in up to 20% of the rural subjects.

The mean intake of total vitamin A (Table VIII) by the urban group (3 978 IU) did not meet the recommendation of 5 000 IU and therefore only furnished 80% of the RDA (Table XI). Table XII indicates that the majority of urban subjects (59%) had poor intakes, 13% were classed as fair and only 28% had satisfactory intakes.

In contrast to the rural group, urban subjects obtained a large proportion (1 660 IU) of their total intake as preformed vitamin A, due to their higher consumption of animal products. On the other hand, intake of vitamin A from carotene sources was much lower for the urban group (2 318 IU) than for their rural counterparts (6 617 IU), mainly because of the much lower consumption of vegetables by urban subjects.

These findings for the urban group are supported by the biochemical data which showed low carotene levels for 70% of the urban subjects. According to the clinical data, 33% of the urban group had skin lesions which might have been associated with low vitamin A values.

Thiamine. A significant difference in thiamine intake was found for all ages (Table XIII). The mean intakes (Table IX) of both urban (1·8 mg) and rural (3·4 mg) groups are well above the recommended allowances, being 133% and 253% of the RDA respectively (Table XI). It is also clear (Table XII) that the majority of subjects in both rural (98%) and urban (91%) samples had satisfactory intakes. The high thiamine values were mainly derived from the large amounts of cereal foods consumed by both groups.

Riboflavine. Intakes of riboflavine also differed significantly for all ages (Table XIII). Table IX shows a higher intake (2·5 mg) by the rural group than by the urban subjects (1·5 mg). The mean intake of rural subjects constitute 150% of the RDA and all age-groups had intakes of more than 100% of the RDA (Table XI). The mean intake of the urban groups, however, did not quite meet the recommendation (91% of the RDA), while in-

TABLE VIII. INTAKE OF VITAMIN A (INTERNATIONAL UNITS)

Age-group (years)	Locality	Preformed (IU) Mean	SD	Min.	Max.	Carotene (IU) Mean	SD	Min.	Max.	Total (IU) Mean	SD	Min.	Max.
<20	Rural	0·0	0·0	0·0	0·0	7 849·8	7 060·6	2 050·5	22 969.5	7 849·8	7 060·6	2 050·5	22 969·5
	Urban	6 904·0	17 653·8	21·6	46 937·3	3 109·2	5 098·4	0·0	13 878·7	10 013·2	17 200·5	21·6	47 398·7
20 - 29	Rural	0·0	1·9	0·0	21·6	7 388·1	7 190·1	0·0	39 668·0	7 388·3	7 190·0	0·0	39 668·0
	Urban	512·3	629·5	0·0	3 139·0	2 239·0	3 178·4	0·0	13 655·1	2 751·4	3 144·1	99·4	13 655·1
30 - 39	Rural	7·9	53·2	0·0	357·0	6 404·1	5 790·0	0·0	24 633·7	6 412·1	5 783·1	0·0	24 633·7
	Urban	1 454·8	7 035·1	19·6	53 509·6	2 457·8	2 637·3	0·0	17 084·4	3 912·6	7 356·1	260·0	54 769·6
40 - 49	Rural	0·0	0·0	0·0	0·0	5 045·3	4 155·4	0·0	17 784·6	5 045.3	4 155·4	0·0	17 784·6
	Urban	794·5	2 232·5	21·6	18 190·9	2 322·4	3 042·1	0·0	25·336·1	3 116·9	3 658·7	21·6	25 415·2
⩾50	Rural	0·0	0·0	0·0	0·0	6 092·5	5 954·6	0·0	23 134·3	6 092·5	5 954·6	0·0	23 134·3
	Urban	3 855·6	22 795·6	0·0	153 357·6	2 066·5	1 707·2	0·0	5 859·0	5 922·1	22 538·6	181·6	153 357·6
All age-groups	Rural	1·4	21·9	0·0	357·0	6 617·0	6 329·3	0·0	39 668·0	6 618·5	6 328·2	0·0	39 668·0
	Urban	1 659·9	10 903·4	0·0	153 357·6	2 317·7	2 823·5	0·0	25 336·1	3 977·6	11 054·8	21·6	153 357·6

TABLE IX. INTAKE OF THIAMINE AND RIBOFLAVIN

Age-group (years)	Locality	Thiamine (mg) Mean	SD	Min.	Max.	Riboflavin (mg) Mean	SD	Min.	Max.
<20	Rural	4·311	2·437	1·895	9·291	3·387	2·577	0·646	8·188
	Urban	1·268	0·461	0·737	1·989	1·677	1·932	0·598	6·020
20 - 29	Rural	3·522	1·854	0·947	9·881	2·511	2·143	0·387	16·162
	Urban	1·691	0·742	0·670	3·814	1·326	0·614	0·555	2·870
30 - 39	Rural	3·716	1·548	1·381	8·285	2·633	1·485	0·547	7·996
	Urban	1·787	0·546	0·622	3·057	1·535	0·662	0·697	4.873
40 - 49	Rural	3·116	1·638	0·394	9·770	2·312	1·529	0·169	7·469
	Urban	1·794	0·697	0·352	4·789	1·514	0·833	0·609	8·283
⩾50	Rural	2·944	1·208	0·495	5·380	2·308	1·582	0·450	7·176
	Urban	1·785	0·642	0·569	2·987	1·692	2·053	0·604	14·763
All age-groups	Rural	3·437	1·739	0·394	9·881	2·501	1·887	0·169	16·162
	Urban	1·761	0·657	0·352	4·789	1·531	1·146	0·555	14·763

takes for the different age-groups ranged from 80% to 105% of the RDA. In both localities a large proportion of subjects had satisfactory intakes, viz. 75% of rural and 64% of urban subjects (Table XII).

Cereal foods supplied a major amount of riboflavin for both groups, but the urban subjects also derived a considerable proportion of their riboflavin from the meat and milk groups.

According to the biochemical data, the riboflavin status of both groups may be considered to have been satisfactory, as a low incidence of low riboflavin excretion values were found for both samples.

Nicotinic acid. A significant difference in nicotinic acid intake was found for all ages (Table XIII). The mean intakes (Tables X and XI) of rural (31·1 g = 179% of RDA) and urban subjects (19·1 g = 113% of RDA) are above the recommended levels for niacin equivalents. Rural intakes, which are considerably higher than urban intakes, constitute more than 100% of the RDA for all age-groups. Urban intakes show a steady increase from 85% of RDA for the youngest group to 130% of RDA for the oldest group.

Table XII indicates that 94% of the rural group had satisfactory intakes, while 83% of urban subjects were classified as 'satisfactory'. It should be pointed out, however, that the above figures apply to gross intake of preformed nicotinic acid and no allowance has been made for possible unavailability of the vitamin. Rural subjects derived a considerable amount of nicotinic acid (53%) from the cereal group (especially from Bantu beer) where the availability of the vitamin might have been low.

Values for possible additional nicotinic acid which may be available through conversion of tryptophan in the diet have unfortunately not yet been assessed. However, on account of the gross deficit of animal protein in the diets of the rural group not much can be expected. The higher animal protein intakes of urban subjects, on the other hand, will almost certainly yield higher values for total available nicotinic acid, and the urban group should thus be in a more satisfactory state of nicotinic acid nutrition than their rural counterparts. It should also be kept in mind that a considerable proportion (52%) of nicotinic acid in the urban diets was derived from the meat group where the availability of the vitamin is high.

TABLE X. INTAKE OF NICOTINIC ACID AND ASCORBIC ACID IN MILLIGRAMS

Age-group (years)	Locality	Nicotinic acid (mg) Mean	SD	Min.	Max.	Ascorbic acid (mg) Mean	SD	Min.	Max.
<20	Rural	40·283	32·632	13·014	127.134	103·62	128·55	5·10	350·03
	Urban	15·323	7·414	7·113	29·044	23·90	26·95	0·06	65·00
20 - 29	Rural	31·639	20·810	7·411	168·943	71·81	106·73	0·00	699·04
	Urban	17·603	8·016	6·006	34·304	20·81	23·24	0·00	95·90
30 - 39	Rural	30·226	12·068	9·490	66·361	44·57	49·05	0·00	241·55
	Urban	18·978	6·717	7·159	39·245	19·80	15·18	0·90	80·69
40 - 49	Rural	30·979	26·721	6·111	194·948	45·60	82·78	0·00	436·30
	Urban	19·640	7·596	5·206	44·498	20·34	22·42	0·00	104·76
⩾50	Rural	26·994	10·617	6·089	52·024	24·43	26·74	0·00	118·31
	Urban	19·629	8·994	5·842	61·022	19·64	22·35	0·06	88·74
All age-groups	Rural	31·066	20·659	6·089	194·948	57·73	90·47	0·00	699·04
	Urban	19·080	7·734	5·206	61·022	20·25	21·01	0·00	104·76

TALBE XI. MEAN DAILY NUTRIENT INTAKES AS PERCENTAGES OF RECOMMENDED DIETARY ALLOWANCES (RDA)

Age-group (years)	Locality	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Ribo-flavin	Nicotinic acid	Ascorbic acid
<20	Rural	153	252	263	3 637	157	308	212	224	173
	Urban	104	156	30	196	200	91	105	85	40
20 - 29	Rural	131	191	212	3 683	148	252	152	176	120
	Urban	131	186	54	221	55	121	80	98	35
30 - 39	Rural	141	176	189	5 282	128	272	155	171	74
	Urban	147	196	56	280	78	131	90	108	33
40 - 49	Rural	135	178	187	5 187	101	239	136	184	76
	Urban	156	198	51	399	62	137	89	117	34
⩾50	Rural	137	165	186	5 536	122	238	136	179	41
	Urban	165	201	55	434	118	144	100	130	33
All age-groups	Rural	135	185	202	4 466	132	253	150	179	96
	Urban	151	195	53	347	80	133	91	113	34

TABLE XII. PERCENTAGE OF SUBJECTS IN VARIOUS CATEGORIES* RELATIVE TO RECOMMENDED NUTRIENT INTAKES

Age-group (years)	Locality	Total No. of sub-jects	Calories			Protein			Calcium			Iron			Vitamin A			Thiamine			Ribo-flavin			Nicotinic acid			Ascorbic acid		
			P	F	S	P	F	S	P	F	S	P	F	S	P	F	S	P	F	S	P	F	S	P	F	S	P	F	S
<20	Rural	10	0	10	90	0	0	100	0	0	100	0	0	100	20	20	60	0	0	100	10	10	80	0	0	100	40	10	50
	Urban	7	0	0	100	0	0	100	86	14	0	0	0	100	57	0	43	0	29	71	28	29	43	14	29	57	57	14	29
20 - 29	Rural	127	2	7	91	0	1	99	6	9	85	0	0	100	26	10	64	0	1	99	13	15	72	2	4	94	43	10	47
	Urban	34	0	0	100	0	0	100	65	15	20	0	0	100	65	3	32	6	6	88	23	24	53	17	15	68	79	6	15
30 - 39	Rural	45	0	2	98	0	2	98	9	7	84	0	0	100	31	11	58	0	0	100	7	11	82	0	7	93	47	20	33
	Urban	57	0	0	100	0	0	100	61	14	25	0	0	100	56	18	26	2	2	96	9	23	68	3	11	86	79	12	9
40 - 49	Rural	54	2	4	94	2	0	98	4	9	87	0	0	100	35	9	56	4	4	92	7	15	78	4	5	91	67	5	28
	Urban	98	0	0	100	0	0	100	62	21	17	0	0	100	58	14	28	2	9	89	10	19	71	5	11	84	77	8	15
⩾50	Rural	30	0	7	93	0	0	100	10	10	80	0	0	100	30	13	57	3	0	97	17	13	70	3	0	97	80	3	17
	Urban	45	0	0	100				71	7	22	0	0	100	60	13	27	2	5	93	11	36	53	7	2	91	80	9	11
All age-groups	Rural	266	1	6	93	<1	1	99	6	8	86	0	0	100	29	11	60	1	1	98	11	14	75	5	4	94	53	10	37
	Urban	241	0	0	100	0	0	100	65	15	20	0	0	100	59	13	28	2	7	91	12	24	64	7	10	83	78	9	13

*P = poor (<50% of RDA).
F = fair (51 - 70% of RDA).
S = satisfactory (>70% of RDA).

The biochemical data showed that 60% of rural and 47% of urban subjects had suboptimal intakes of this vitamin. On clinical examination, overt pellagra was found only in subjects above 40 years of age, viz. in 7% of rural and 2% of urban subjects.

TABLE XIII. SUMMARY OF RESULTS OBTAINED BY STEFFENS' TEST[3]

Nutrient	Age interval for which nutrient intake between rural and urban groups showed a significant difference at a 5% level
Total weight of food	All ages
Moisture	All ages
Fibre	All ages
Calories	37 years and older
Alcohol	All ages
Animal protein	All ages
Vegetable protein	All ages
Total protein	43 years and older
Animal fat	All ages
Vegetable fat	Up to 50 years
Total fat	All ages
Carbohydrate ('sugar')	All ages
Carbohydrate (starch)	Up to 46 years
Total carbohydrate	Up to 32 years
Calcium	All ages
Phosphorus	All ages
Iron	All ages
Sodium	22 years and older
Potassium	All ages
Thiamine	All ages
Riboflavin	All ages
Nicotinic acid	All ages
Ascorbic acid	Up to 46 years

Ascorbic acid. Intakes of ascorbic acid differed significantly up to the age of 46 years (Table XIII). The mean intake (Tables X and XI) of urban subjects (20·3 mg = 34% of RDA) is considerably lower than that of the rural group (58·0 g = 96% of RDA). Intakes of both samples also tend to decrease with increasing age.

Table XII indicates that only a small percentage (13%) of urban subjects had satisfactory intakes, while the majority (78%) had poor intakes and 9% were classified as fair. A larger proportion of the rural group (37%) had satisfactory intakes, but the majority of subjects were also classified as poor (53%) and fair (10%). The largest number of subjects with poor intakes were found in the older age-groups of both localities.

Although the rural subjects could easily have obtained fruit from the area in which they lived, 94% of their total ascorbic acid intake was derived from the vegetable group. Only a few urban subjects bought fruit regularly. It appears that adult Bantu men regard fruit as food fit for women and children only. The small amount of ascorbic acid in the urban diet has therefore also been derived mainly from vegetable sources (83%). The urban diet, however, did not include vegetables to the same extent as did the rural diet.

The biochemical data showed significant differences between the two samples for serum levels of ascorbic acid. Rural subjects on the whole had higher serum levels than their urban counterparts. In addition, a higher proportion of urban subjects were considered to be in the low range. The clinical data also suggest that a considerable proportion of subjects in both localities might have obtained suboptimal quantities of this vitamin.

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