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A SURVEY OF THE HAEMATOLOGICAL, NUTRITIONAL AND BIOCHEMICAL STATE OF THE RURAL ELDERLY WITH PARTICULAR REFERENCE TO VITAMIN C

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Summary

A survey of the rural elderly has been carried out to determine basic haematological and biochemical data, and to establish a pattern of living for this 'well' population. The blood parameters related to diet, such as haemoglobin, folate, cholesterol, vitamin C etc., show considerable changes with increasing age in the male but little significant change in the female. The vitamin C status for both sexes compares favourably with that reported by other workers studying the urban elderly. The biochemical and haematological data derived provide a normal range with which the 'sick' elderly can be compared. The subjects were generally active and independent in spite of (or because of) a somewhat Spartan existence.

Introduction

In most 'normal' population surveys the data become very scanty in the upper age groups and only recently have attempts been made to examine more closely the 'well' elderly in their own homes. Most studies of the clinical, nutritional, biochemical and haematological state of the elderly have been carried out in predominantly urban areas and have shown varying degrees of nutritional deprivation depending on the actual place of residence, e.g. at home or in geriatric institutions. Several recent vitamin C studies have been carried out in urban areas (Burr et al. 1974), while Wilson et al. (1972) studied admissions to hospital in Cornwall, a generally rural area, but gave no indication as to the principal source of the patients, urban or rural. In Herefordshire, a mainly rural area, a few cases of flagrant scurvy had been encountered among the elderly in preceding years, and it was considered pertinent to examine the general nutritional state and the vitamin C status of the rural elderly as opposed to the urban elderly.

A survey was devised to examine the clinical and general nutritional state of the rural elderly by means of a questionnaire, covering clinical and dietetic factors, and a series of haematological and biochemical investigations. Vitamin C status was to be investigated in rather more detail than usual, with platelet and leucocyte vitamin C assays as well as the more generally utilized 'buffy layer' vitamin C. Attwood et al. (1974) have already made a preliminary examination of the platelet and leucocyte vitamin C and the possible significance of the relative contributions of each to the buffy layer vitamin C. In addition to the vitamin C studies, serum iron, iron binding capacity (IBC) and cholesterol were examined. Jacobs et al. (1971) and other workers have examined the relationship between ascorbic acid status and iron deficiency anaemia and have suggested that the total amount

of iron in the tissues may be an important factor in determining ascorbic acid utilization. The association between serum cholesterol and hypovitaminosis C is very much a current problem. Spittle (1971) has shown a fall in serum cholesterol during the administration of large doses of vitamin C while others (Anderson et al. 1972) have shown an increase during similar treatment.

Subjects

364 subjects over the age of 65 years on the National Health Service list of one rural practice were visited and interviewed by the clinical assistant (J.R.). If the subject agreed, the clinical and dietetic questionnaire was completed and 25 ml blood taken. The subjects were also invited to take part in a double-blind trial to assess the effects of oral vitamin C, 301 (83%) did so and these results will be presented in a separate paper.

Leucocyte, platelet and buffy layer vitamin C studies were also carried out on a series of younger symptomless subjects: 45 females (mean age 27 years, range 16–53) and 25 males (mean age 27 years, range 16–59).

Methods

The platelet, leucocyte and buffy layer vitamin C were assayed by the method of Attwood et al. (1974) using the 2,4-dinitrophenylhydrazine reaction under strongly acidic conditions.

Serum cholesterol estimations were done by a slightly modified Watson procedure (1960) utilizing *p*-xylenesulphonic acid. Serum iron and IBC were assayed using the bathopheanthroline disulphonate technique with reagents supplied by Roche Products Ltd. (15 Manchester Square, London W1M 6AP).

A full haematological screen of haemoglobin (Hb), leucocyte count (WBC), red blood cell count (RBC), packed cell volume (PCV), mean cell volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) was carried out with a Coulter S (Coulter Electronics Ltd, Coldharbour Lane, Harpenden, Hertfordshire, AL5 4UN). A blood film examination and differential leucocyte count were also done.

Serum vitamin B_{12} was assayed by the Raven (Raven & Robson 1974) modification of the Phadebas radioimmunoassay B_{12} test kit supplied by Pharmacia (Pharmacia, Great Britain Ltd, Paramount House, 75 Uxbridge Road, London N5 5SS). Serum and red-blood-cell folate were assayed by the *L. casei* microbiological assay*. The blood for the red-blood-cell folate assay was preserved by adding 0.5 ml blood to 4.5 ml aqueous ascorbic acid 57 mmol/l.

The questionnaire was designed so that the information could be processed by a computer to determine:

1. The subjects' patterns of living as shown by the time lived in the area, the number of people in their households and the proximity of their nearest relatives.
2. Their degree of independence as shown by their use of 'meals on wheels', or the taking of meals in other homes, and their contact with their general practitioners and the hospital services.
3. Their general health or morbidity, with particular reference to past fractures, the presence of multiple pathology, and the presence of gastrointestinal conditions (e.g. duodenal ulceration and malabsorption).
4. Their mental state as shown by their appearance and behaviour.
5. The presence or absence of symptoms suggesting scurvy, e.g. bleeding gums, when the subject has his/her own teeth, skin lesions, pain and weakness of lower limbs, anorexia and depression.
6. The presence or absence of factors known to affect blood vitamin C levels, e.g. smoking, drugs (tetracycline, aspirin, antirheumatic), consumption of alcohol, and cooking with bicarbonate.
7. Their dietary habits, i.e. the availability of garden produce and their consumption of fruit, tomatoes and potatoes.

* Folate assays were carried out by the Department of Haematology, General Hospital, Birmingham.

Results and Discussion

Of 364 subjects (174 males and 190 females) who were approached, 301 subjects, 146 males and 155 females with mean ages of 72.9 and 73.4 years respectively, agreed to take part in the survey. This represents an overall response rate of 83%, which compares well with that of 86% in a similar survey conducted by Burr et al. (1974) in Wales and a 70% response rate by English elderly subjects in Coventry (Elwood et al. 1972).

Haematological Survey

The haematological data are presented in Tables I to IV. The females show no changes in haematological parameters with increasing age, except for a slight fall in serum folate. The values found generally compare well with the recognized normal ranges, although the neutrophil and lymphocyte counts are slightly lower in this survey.

Table I. Haematological survey data (female): Mean ± S.E.M.

	Age group (years)					*Laboratory mean (range)*
	65–69	70–74	75–79	80–84	85+	
Haemoglobin g/dl	13.77 ±0.15	13.83 ±0.21	13.86 ±0.17	14.18 ±0.22	13.96 ±0.65	14.0 (11.5–16.5)
Leucocytes 10^9/l	6.46 ±0.22	6.15 ±0.20	6.85 ±0.32	5.98 ±0.37	7.02 ±0.70	7.5 (4–11)
Neutrophils 10^9/l	3.74 ±0.17	3.62 ±0.18	4.15 ±0.24	3.46 ±0.29	4.72 ±0.62	4.75 (2.0–7.5)
Lymphocytes 10^9/l	2.24 ±0.10	1.91 ±0.10	1.99 ±0.14	2.11 ±0.19	1.78 ±0.21	2.75 (1.5–4.0)
Platelets 10^{11}/l	2.68 ±0.09	2.47 ±0.09	2.93 ±0.21	2.29 ±0.16	2.56 ±0.26	2.75 (1.5–4.0)
Erythrocytes 10^{12}/l	4.68 ±0.06	4.74 ±0.08	4.57 ±0.08	4.69 ±0.07	4.61 ±0.20	4.8 (3.8–5.8)
MCV fl	87.30 ±0.74	86.41 ±0.60	87.86 ±0.77	88.53 ±0.83	87.80 ±1.35	86.5 (77–96)
MCHC g/dl	33.67 ±0.17	33.59 ±0.17	34.41 ±0.58	34.17 ±0.19	33.70 ±0.38	
MCH pg	29.50 ±0.27	29.18 ±0.22	30.34 ±0.53	30.15 ±0.36	29.96 ±0.69	29.5 (27–32)
PCV	0.412 ±0.006	0.411 ±0.006	0.404 ±0.006	0.415 ±0.006	0.407 ±0.017	0.42 (0.37–0.47)
Number in group	56	41	29	19	10	

The males, however, do show some changes with age. The haemoglobin, red-cell count, packed-cell volume and serum folate fall with increasing age, while the leucocyte count increases steadily. By comparison the erythrocyte folate, for both sexes, shows no change with advancing age.

The incidence of abnormal blood film findings (11 females and 7 males) is low. In addition there were 3 females with haemoglobin levels less than 11.5 g/dl and 7 males with

haemoglobin levels less than 13.0 g/dl but no abnormal blood film findings were reported. Only two subjects, both male, were judged to have iron deficiency anaemia, and three subjects, with signs of macrocytosis, had low levels of serum vitamin B_{12}. Our results show that there seems to be a very low incidence of haematological disorders in this elderly community.

Table II. Haematological survey data (male): Mean ± S.E.M.

	Age group (years)					*Laboratory mean (range)*
	65–69	70–74	75–79	80–84	85+	
Haemoglobin g/dl	15.25 ±0.19	14.63 ±0.18	14.86 ±0.30	14.11 ±0.32	13.26 ±0.45	15.5 (13.0–18.0)
Leucocytes 10^9/l	6.49 ±0.18	6.87 ±0.31	6.94 ±0.33	7.48 ±0.59	7.79 ±0.63	7.5 (4–11)
Neutrophils 10^9/l	3.68 ±0.13	4.07 ±0.29	4.62 ±0.40	4.84 ±0.40	4.44 ±0.43	4.75 (2.0–7.5)
Lymphocytes 10^9/l	2.14 ±0.09	2.03 ±0.10	1.66 ±0.08	2.24 ±0.27	2.42 ±0.41	2.75 (1.5–4.0)
Platelets 10^{11}/l	2.44 ±0.11	2.49 ±0.10	2.23 ±0.10	2.29 ±0.21	2.70 ±0.28	2.75 (1.5–4.0)
Erythrocytes 10^{12}/l	5.05 ±0.07	4.81 ±0.10	4.95 ±0.10	4.64 ±0.11	4.47 ±0.17	5.5 (4.5–6.5)
MCV fl	89.35 ±0.60	89.29 ±1.01	88.72 ±0.84	89.00 ±1.01	88.87 ±2.15	86.5 (77–96)
MCHC g/dl	33.85 ±0.17	34.15 ±0.19	33.80 ±0.19	33.81 ±0.33	33.07 ±0.45	
MCH pg	30.21 ±0.21	30.54 ±0.38	30.02 ±0.29	30.48 ±0.53	29.50 ±0.80	29.5 (27–32)
PCV	0.450 ±0.006	0.426 ±0.006	0.438 ±0.009	0.418 ±0.009	0.397 ±0.015	0.42 (0.37–0.47)
Number in group	51	43	29	15	8	

Table III. Serum vitamin B_{12}, serum and erythrocyte folate, male and female: Mean ± S.E.M.

	Age group (years)									
	65–69		70–74		75–79		80–84		85+	
	M	F	M	F	M	F	M	F	M	F
Serum vitamin B_{12} ng/l	521 ±30	538 ±26	495 ±21	541 ±22	585 ±46	588 ±34	572 ±69	534 ±31	578 ±78	651 ±157
Serum folate µg/l	5.5 ±0.5	5.2 ±0.4	4.6 ±0.4	5.0 ±0.4	4.0 ±0.4	4.1 ±0.4	3.5 ±0.3	3.7 ±0.5	2.6 ±0.3	6.1 ±1.1
Erythrocyte folate µg/l	267 ±14	333 ±20	277 ±26	295 ±25	249 ±17	276 ±25	195 ±28	236 ±16	258 ±37	269 ±52
Number in group	51	56	43	41	29	29	15	19	8	10

Table IV. Biochemical survey data (male): Mean ± S.E.M.

	Age group (years)					
	16–59	65–69	70–74	75–79	80–84	85+
Platelet vitamin C	34.2	23.6	24.6	24.3	20.5	16.9
$\mu g/10^{10}$ cells	±2.1	±1.6	±2.2	±2.6	±5.0	±4.7
		<0.001	<0.005	<0.01	<0.01	<0.001*
Leucocyte vitamin C	11.2	12.0	12.0	12.4	10.4	8.8
$\mu g/10^8$ cells	±0.7	±0.7	±0.8	±1.2	±1.3	±0.5
Buffy layer vitamin C	23.0	21.6	21.5	19.4	17.1	15.1
$\mu g/10^8$ wbc	±1.2	±1.0	±1.6	±1.5	±2.3	±2.4
				<0.10	<0.05	<0.005*
Serum iron		102	95	91	81	65
μg/dl		±4	±6	±6	±9	±8
					<0.05	<0.005†
Serum IBC		340	343	351	327	319
μg/dl		±7	±11	±10	±17	±20
Serum cholesterol		251	232	222	214	209
mg/dl		±6	±6	±7	±10	±14
						<0.05†
Number in group	25	51	43	29	15	8

* Significance from 16–59 age group.
† Significance from 65–69 age group.

Biochemical Survey

The results of the biochemical survey are presented in Table IV for males, and Table V for females, with the addition of the vitamin C results for the young symptomless group. The mean buffy layer vitamin C for the first two groups of males does not differ to any great extent from the younger group, while for the last three groups the difference has become significant. The mean leucocyte vitamin C in the elderly male is relatively constant and only for the 85-plus group is it significantly lower than in the young group. The mean platelet vitamin C for males in the survey is significantly lower than in the younger group, and there is a further decline from 80 years onwards.

For the female elderly, the vitamin C results are different from those of males. Although the general levels are significantly lower than in the young there is no fall-off with advancing age.

The buffy layer vitamin C values for the females in the 65–69 and 70–74 age groups are comparable with those found by Burr et al. (1974) in a small Welsh town. But in higher age groups, Burr's values show some fall while in this study no such fall was observed. For the males the results are again similar to Burr's except that in this study the buffy layer vitamin C levels for the first three age groups are slightly higher. This could be due to a better intake of fresh fruit and vegetables in a rural area.

The serum iron in the elderly male falls steadily from a mean of 102 μg/dl at 65–69 years, to 65 μg/dl at 85 plus, the latter being significantly different from the former. The serum iron binding capacity only falls in those above 80 years. There were seven male subjects with a serum iron less than 30 μg/dl but only two showed a marked iron deficiency anaemia.

Table V. Biochemical survey data (female): Mean ± S.E.M.

	Age group (years)					
	16–59	65–69	70–74	75–79	80–84	85+
Platelet vitamin C	36.4	27.1	24.7	27.2	26.1	30.3
$\mu g/10^{10}$ cells	±1.9	±1.6	±2.0	±2.2	±2.9	±3.5
		<0.001	<0.005	<0.005	<0.005	>0.10*
Leucocyte vitamin C	14.0	13.2	15.5	12.1	13.3	14.5
$\mu g/10^8$ cells	±0.9	±0.6	±1.1	±1.0	±1.0	±2.1
Buffy layer vitamin C	29.6	24.5	25.4	23.6	23.9	25.8
$\mu g/10^8$ wbc	±1.5	±1.2	±1.4	±1.6	±1.6	±3.0
		<0.01	<0.05	<0.05	<0.05	*
Serum iron		88	86	88	81	81
$\mu g/dl$		±4	±5	±5	±5	±12
Serum IBC		360	356	342	364	375
$\mu g/dl$		±6	±8	±11	±13	±23
Serum cholesterol		264	252	271	247	249
		±7	±8	±9	±10	±15
Number in group	45	56	41	29	19	10

* Significance from 16–59 age group.

In contrast, the mean serum iron for the female is initially lower than for the male but remains relatively constant with increasing age. There were six females with serum iron levels of less than 30 $\mu g/dl$, of which one exhibited hypochromasia and a second a microcytic, hypochromic, anisocytotic blood film.

In the assay system for serum iron one specimen produced a turbidity which, on further investigation, revealed the presence of an abnormal protein band (IgG 9.7 g/l, IgA, 1.4 g/l and IgM 9.4 g/l).

In the male the mean serum cholesterol level shows a steady fall with advancing age, which at 85-plus years is significantly different ($P < 0.02$) from the mean level at 65–69 years. In sharp contrast, the serum cholesterol level in the elderly female is generally higher than for the male and shows little change with advancing age.

There has been much discussion recently concerning the possible relationship between vitamin C and cholesterol. In this study the two parameters show similar patterns, a steady fall with increasing age in the male and no change in the female. It could always be argued that the elderly males with lower cholesterol levels are the survivors of ischaemic heart disease. In view of the changes in the other parameters, e.g. Hb, folate and iron, a more likely explanation for this fall in males and the lack of change for these values in the female is that the cholesterol variations are of dietary origin.

The information derived from the questionnaire may be summarized as follows. The stability of the population is demonstrated by the fact that 80% had lived in the area for more than 10 years. There is a high degree of independence as shown by the fact that 14% males and 26% females lived alone and 40% lived more than 5 miles from the nearest relative. This independence is emphasized by the fact that 85% never have a meal outside their own homes, 95% have regular meals and only 8% avail themselves of the

meals-on-wheels service. This population is generally very active with 81% doing their own shopping, 72% walking more than one mile per day, only 8% being confined to one floor and less than 1% being bedridden. This is not a particularly affluent population, 45% having the old-age pension as the sole means of support.

The two general practitioners (N.O. and S.S.) involved in this survey do not visit their elderly patients routinely. The surgeries are located in two large villages with three branch surgeries in hamlets. The fact that 59% of the subjects live more than one mile from the nearest surgery indicates how sparsely the area is populated; 35.8% males and 49.7% females had not attended a general practitioner in surgery during the previous year and 54.7% males and 43.2% females had not been visited at home.

The clinical assistant found that 90% of the subjects were co-operative and sociable and welcomed her visit, and only 10% were unkempt.

The general clinical information derived from the questionnaire is presented in Table VI.

Table VI. General clinical information

	No (%)		*Yes* (%)	
	Male	*Female*	*Male*	*Female*
Own teeth	76.4	80.6	23.6	19.4
Presence of skin lesions	81.1	65.8	18.9	34.2
Pain in lower limbs	66.2	50.7	33.8	49.3
Weakness in lower limbs	73.6	70.3	26.4	29.7
Anorexia	90.5	84.5	9.5	15.5
Depression	81.1	63.9	18.9	36.1
Peptic ulcer	86.4	89.7	13.7	10.3
Diarrhoea	90.4	85.8	9.6	14.2
Frequent falls	84.5	80.0	15.5*	20.0†
Past fractures	97.8	88.4	2.2	11.6
Multiple pathology	58.1	55.5	41.9	44.5

* 1 subject felt dizzy.
† 3 subjects felt dizzy.

As it was felt that any physical examination was beyond the brief of the clinical assistant, the geriatrician visited the 21% subjects with skin lesions. The skin lesions were for the most part senile purpura, or telangiectatic areas due to exposure to severe weather. There was no clinical evidence of scurvy. A few subjects had minimal corkscrewing of hairs on the backs of their thighs. Questions about pain in the lower limbs (41%) and weakness of lower limbs (28%) were included in the questionnaire as these are the symptoms complained of most frequently in scurvy. Both have multifactorial causes, of which the more common in a rural area are osteoarthrosis of the hips and spine, and varicose veins. When the geriatrician examined the subjects with positive skin lesions she noted a very high proportion of the women with varicose veins. It is worth mentioning that at least 20% of all the elderly in the survey had their own teeth.

Anorexia and depression are the other presenting symptoms of scurvy, hence their inclusion in the questionnaire. Twenty-seven per cent complained of depression and of

these there were twice as many females as males. From the observations of the general practitioners and the clinical assistant this was thought not to be true depression, but possibly a sign of loneliness, which is probably related to the lack of social amenities in rural areas. The young people are moving away, public transport is being progressively restricted and there are few Over-60s' Clubs and no Day Centres. It is interesting that, whereas 75% of the men take some alcohol, only 46% of the women do. The 'pub', church, and various functions organized by voluntary bodies, chief of which is the Women's Institute, are usually the only forms of entertainment.

Multiple pathology was complained of by 40% of the subjects and this correlates with the 42% incidence of visits within the previous year to the general practitioners' surgery and a similar scale of G.P.s attendance to the subjects' homes. When it is accepted that multiple pathology is a feature of old age, this 40% incidence is moderate to low.

There was no correlation between the various blood parameters for those with or without duodenal ulcers, diarrhoea, their own teeth, with multiple pathology, with pension as the sole means of support or with those receiving any drugs listed in the

Table VII. Seasonal variation in buffy layer vitamin C, male and female: Mean ± S.D.

	Sex	*April–September* (*No. in group*)	*October–March* (*No. in group*)	
Buffy layer vitamin C $\mu g/10^8$ wbc	M	21.71 (69) ±9.48	19.03 (77) ±7.91	$P<0.1$
	F	26.49 (81) ±8.93	22.51 (73) ±7.20	$P<0.005$

questionnaire. Cooking with bicarbonate (26% subjects) rather surprisingly produced higher buffy layer vitamin C levels than for those who did not. The difference for males (23.56 $\mu g/10^8$ wbc and 19.35 $\mu g/10^8$ wbc) being significant ($P<0.01$), and that for females (27.58 $\mu g/10^8$ wbc and 23.92 $\mu g/10^8$ wbc) not significant.

The biochemical and haematological results show that the nutritional state of the elderly female is superior to that of her male counterpart. In the male all the parameters, depending on diet for the maintenance of normal young adult levels, show a steady decline with advancing age. The buffy layer vitamin C results for females living alone are the same as for those living with others, 24.80 μg and 24.53 $\mu g/10^8$ wbc respectively, while males living alone have slightly lower values 18.81 μg and 20.54 $\mu g/10^8$ wbc respectively. Table VII compares the buffy layer vitamin C content in the summer and winter periods. While the mean levels of buffy layer vitamin C for both sexes show a fall in the winter months, that for the female is almost double that for the male. These changes are greater than those shown by Andrews et al. (1966), who only studied a small number of elderly subjects living alone and did not differentiate between males and females. Although we have found seasonal variation in vitamin C levels this would have little effect on the overall figures as there was even distribution of visits throughout the year.

Table VIII shows the relationship of buffy layer vitamin C levels to consumption of fruit, tomatoes and potatoes. These results contrast with the 'official' view that 'the potato is the main source of vitamin C in many diets' (Her Majesty's Stationery Office

Table VIII. Buffy layer vitamin C levels related to fruit, tomato and potato consumption

[Less (L) = None or slight, More (M) = plentiful summer or all year]

Female								
No. of subjects	21	12	18	12	11	10	43	28
Fruit	L	L	L	M	M	L	M	M
Tomatoes	L	M	L	L	L	M	M	M
Potatoes	L	M	M	L	M	L	M	L
Buffer layer vitamin C ($\mu g/10^8$ wbc)	21.76	22.17	22.83	22.91	23.27	23.50	26.77	27.18
Male								
No. of subjects	12	4	28	34	12	11	39	6
Fruit	L	M	L	L	M	M	M	L
Tomatoes	L	L	L	M	L	M	M	M
Potatoes	L	L	M	M	M	L	M	L
Buffy layer vitamin C ($\mu g/10^8$ wbc)	14.42	15.75	18.86	20.32	20.83	20.91	22.74	23.50

Table IX. Alcohol consumption and its relationship to various blood parameters

Mean	*No.*	*Hb g/dl*	*MCV fl*	*Erythrocytes* $10^{12}/l$	*Serum vit.* B_{12} *ng/l*	*Serum folate* $\mu g/l$	*Erythrocyte folate* $\mu g/l$	*Leucocytes* $10^9/l$	*Buffy layer vit. C* $\mu g/10^8$ *wbc*	*Leucocyte vit. C* $\mu g/10^8$ *cells*
None										
M	36	14.38	88.16	4.78	521	4.43	248	6733	20.55	11.50
F	67	13.83	86.94	4.68	575	3.94	280	6364	22.81	12.31
Light										
M	98	14.86	89.10	4.91	529	4.60	265	6903	20.49	12.07
F	85	13.89	87.48	4.67	538	5.42	306	6403	26.12	14.67
Heavy										
M	10	14.99	93.50	4.91	617	3.12	230	7039	17.50	9.40
F	3	14.03	92.67	4.64	555	5.73	333	—	22.31	15.67

1976). The figures also suggest the different levels of buffy layer vitamin C in the sexes are not solely due to dietary variations. The survey showed a high availability (77%) of garden produce throughout the year which may explain the higher buffy layer vitamin C levels found in this survey compared with that of Burr et al. (1974). The consumption of tomatoes is comparable in the sexes, while females eat more fruit and far less potatoes than the males.

With regard to alcohol consumption, 25% males and 44% females did not partake, 68% males and 54% females drank occasionally and 7% males and 2% females admitted to frequent drinking. Table IX shows there are no startling changes in the blood parameters related to alcohol consumption. In the females the MCV, serum and erythrocyte folate and leucocyte vitamin C rose slightly with increasing alcohol consumption while the buffy layer vitamin C fell in the males. O'Keane et al. (1972) found subclinical scurvy associated with an inadequate intake of ascorbic acid in alcoholics.

Thirty-four per cent of the males and 7% of the females smoked more than 20 cigarettes or 2 ounces tobacco per week; 21% males and 1% females smoked less, while 45%

Table X. Smoking and its relationship to various blood parameters (males)*

Mean	*No.*	*Hb g/dl*	*MCV fl*	*Erythrocytes $10^{12}/l$*	*Serum vit. B_{12} ng/l*	*Serum folate µg/l*	*Erythrocyte folate µg/l*	*Leucocytes $10^9/l$*	*Buffy layer vit. C µg/10^8 wbc*	*Leucocyte vit. C µg/10^8 cells*
Non-smokers	64	14.59	87.87	4.89	530	4.56	272	6829	21.68	12.32
Light smokers	31	15.32	89.94	5.08	563	4.83	243	7103	17.35	11.00
Heavy smokers	49	14.60	90.38	4.73	521	4.19	249	6778	20.34	11.40

* There were insufficient female smokers for a valid comparison.

males and 92% females did not smoke at all. This contrasts sharply with the larger number of females in the younger age groups who now smoke. Table X shows there are few differences in blood parameters between the smokers and non-smokers except the light smokers have a lower buffy layer vitamin C than either the non-smokers or heavy smokers. This differs from the findings of other workers (Brook & Grimshaw 1968, Pelletier 1968) who in the main concentrated on the younger age groups and used much smaller numbers.

In this study we have attempted to analyse the life-style of the rural elderly and to produce a base-line for blood investigations against which those who have symptoms can be compared.

Conclusion

We set out to find scurvy amongst the rural elderly of Herefordshire. To do this adequately we had to get an overall picture of their life-style, general health, and blood biochemistry related to nutrition.

This appendage to the main theme is probably the main value of this paper. Hitherto there has been no determination of these values for the normal elderly living in a traditional rural English community.

Far from discovering scurvy we found a unique community, active and independent in spite of (or because of) a somewhat Spartan existence. That they did not regard themselves as particularly fortunate is suggested by the incidence of depression amongst them, probably related to their isolation.

Not included in detail in this paper are eight subjects with subclinical evidence of vitamin C deficiency. This and other results of the double-blind trial of vitamin C and placebo will be considered in a separate paper.

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