Iron, folate and vitamin B12 status of an elderly South African population

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Iron, folate and vitamin B_{12} status of an elderly South African population

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Objectives: To determine the prevalence of anaemia and the haemopoietic nutrient status of older mixed ancestry (coloured) South Africans.
Design: A cross-sectional analytic study.
Subjects: A random sample of 200 non-institutionalized subjects aged ≥ 65 y of age, resident in urban Cape Town, was drawn using a two-stage cluster design.
Methods: Trained fieldworkers interviewed subjects to obtain demographic and lifestyle data. Dietary intake was assessed using a validated food frequency questionnaire. Fasting blood samples were drawn for the determination of haematological parameters, serum vitamin B_{12}, serum folate, RBC folate and a full blood count.
Results: The prevalence of anaemia was 13.9. Eight of the 26 cases of anaemia (31) were associated with suboptimal haemopoietic nutrient status; 2(25) and 3(38) cases of these 8 anaemic subjects had suboptimal vitamin B_{12} and folate status, respectively. Iron deficiency anaemia accounted for 5(63) of the subjects with nutrition-related anaemia. Ten men and two women (6.5 of subjects) had raised serum ferritin concentrations, half of whom had abnormal biochemical parameters indicative of alcohol abuse.
Conclusions: Older coloured South Africans, particularly women, should be encouraged to eat diets with a high nutrient density and to consume adequate amounts of foods high in iron, folate and vitamin B_{12}. Further investigation regarding the high prevalence of hyperferritinaemia found in the men in this population is indicated.
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Descriptors: vitamin B_{12}; ferritin; folate; anaemia; elderly; South Africans

Introduction

Currently, 1.7 million South Africans are aged 65 y and over, a figure projected to rise to over seven million by the year 2035 (CSS, 1992). Modern geriatric medicine aims at achieving optimal function and independence in the elderly; indeed, with increasing life expectancy the compression of morbidity to the last few years of life is of paramount importance, both from a quality of life and a financial point of view (Fries, 1992). Malnutrition is known to have a significant adverse effect on morbidity and mortality in the elderly (Dallman *et al*, 1984). More specifically, vitamin and mineral deficiencies have been repeatedly documented and are thought to be due, among other factors, to lower energy requirements of the elderly which result in a reduced food intake and the consumption of foods which are poor in nutrient density (Munro *et al*, 1987). Micronutrient malnutrition impacts adversely on the elderly; suboptimal folic acid and vitamin B_{12} status, together with other vitamins, have been shown to impair cognitive function and immune status (Rosenberg and Miller, 1992).

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Anaemia has many possible causes in the elderly. Although the prevalence of iron deficiency anaemia tends to decrease after the age of 65 y (Beal, 1980), especially in women, it can be present in up to 20 of elderly people seeking medical attention (Joosten *et al*, 1992; Kikerby *et al*, 1991). The prevalence of folic acid and vitamin B_{12} deficiencies, based on the determination of serum concentrations, varies (0–20) according to the population being studied; however, on the basis of the determination of abnormal intermediary metabolites, a substantially higher prevalence (39–68) of deficiency has recently been reported (Joosten *et al*, 1993).

The multifactorial causes of micronutrient deficiencies, particularly iron, folic acid and vitamin B_{12}, include achlorhydria and lower secretion of intrinsic factor (Bogden *et al*, 1994), chronic disease and inflammation (Dallman *et al*, 1984), chronic polypharmacy (Beal, 1980), gastro-intestinal bleeding (Jacobs *et al*, 1984) as well as poverty, physical inability to prepare food, alcoholism and inadequate dietary intake (Hoffman, 1993). In South Africa, inadequate dietary intake of these micronutrients has been reported in Caucasian hospitalized elderly (Gouws *et al*, 1989), whereas iron intake appears to be adequate in rural African women (Walker *et al*, 1989). Similar data for mixed ancestry (Afro–Euro–Malay) elderly are, however, sparse therefore this study was undertaken to determine the prevalence of anaemia and assess the haemopoietic nutrient status of this population.

Methods

A sample of 200 non-institutionalized coloured subjects (104 females; 96 males) aged 65 y and older, resident in Cape Town, was recruited for a cross-sectional analytic study conducted in 1993 using a two-stage cluster sampling technique, based on 1991 Population Census data (CSS, 1992). The only exclusion criterion was an inability to answer three questions relating to cognitive function about their name, address and the current year. The study formed part of the International Union of Nutritional Sciences (Committee on Nutrition and Ageing) cross-cultural studies on food habits and health in later life (Wahlqvist *et al*, 1995). Written informed consent was obtained from all participants and the study was approved by the Ethics and Research Committee of the University of Cape Town and Allied Teaching Hospitals.

Trained fieldworkers interviewed subjects in their homes to obtain demographic, dietary and lifestyle data and to draw blood samples. Dietary intake was assessed using a quantified food frequency questionnaire with the past month as the reference period; the dietary methods are described in detail elsewhere (Charlton and Wolmarans, 1995). Vitamin and mineral supplements were not taken into account during dietary analyses.

Fasting blood samples were drawn from all consenting subjects ($n = 191$) for the following analyses: full blood count (Coulter S Plus II analyser, Hialeah, Florida); serum folate, red cell folate and serum vitamin B_{12} levels (Becton, Dickenson Simultrac-SNB, New York); serum gamma glutamyltransferase (GGT) (enzymatic conversion of a gammaglutamyl-nitroanihide substrate-Hitachi 747 (Boehringer Mannheim)); and ferritin (immunoturbidimetric methods, Boehringer Hitachi 704).

The food frequency questionnaires were coded by three dieticians using the 1991 Food Quantities Manual (Langenhoven *et al*, 1991a); average daily nutrient intakes were calculated using the South African Food Composition Tables database (Langenhoven *et al*, 1991b). Mean energy and micronutrient intakes were expressed as a percentage of the Recommended Dietary Allowances (RDA) for men and women 51 plus years of age (NRC, 1989) and an inadequate intake was taken as being two-thirds or less than the RDA.

The percentage contribution of the five basic food groups—the calcium-rich food group, the protein-rich food group, the fruit and vegetable food group, the cereal food group, and the fat food group—to total energy, protein, folate, iron and vitamin B_{12} intake was calculated. Foods such as cakes, tarts, puddings, meat pies, soups, sauces, snacks, cool drinks and alcoholic drinks were incorporated into an 'other' food group (Langenhoven *et al*, 1989).

Means and standard deviations were used to describe normally distributed continuous variables; medians and quartile values were used to describe non-parametric data. Differences between the parameters by sex were tested using the Wilcoxon 2-sample text. Associations between the parameters by sex were tested using the Spearman correlation coefficients.

Results

The mean age of the subjects was 73.7 (s.d. = 5.9, range 65–92 y). The age distribution of the sample was similar to that of the national coloured population aged 65 y and older (CSS, 1992), for both sexes. The subjects were in a low income group: 87 received a means-tested government old age pension as their main source of income ($\pm$ US \$80 per month) and 15.5 had received no formal education. Most of the subjects (82) lived in multigenerational households of five people, on average; only 4 lived alone.

The mean haemoglobin concentration, red cell count, haematocrit and ferritin concentration tended to be lower in the women than the men, while the men tended to have lower folate concentrations (Table 1). The prevalence of anaemia (HB < 13 g/dL in men; < 12 g/dL in women), abnormal haematologic results and low concentrations of haemopoietic nutrients in the subjects are shown in Table 2. Anaemia was diagnosed in at least one in seven of the subjects studied. Macrocytosis and increased serum ferritin were more prevalent in the men than in the women; a higher prevalence of microcytosis and low serum ferritin was present in the women. Low red cell haemoglobin (MCH) was found in a quarter of the subjects. Deficient iron stores (low serum ferritin) and folate (RBC) deficiency was more common than vitamin B_{12} deficiency.

Individual results of subjects with anaemia are shown in Table 3. Iron deficiency anaemia (n = 5) was more common than anaemias associated with folate (RBC) and vitamin B_{12} deficiency (n = 3 and 2, respectively). In two cases anaemia was associated with deficiencies of more than one haemapoeitic nutrient. Additionally, 3 subjects who were not anaemic had deficient RBC folate concentrations while 1 subject had vitamin B_{12} deficiency.

Table 4 lists the individual results of subjects with high serum ferritin ($n = 12$). Increased gamma-glutamyltransferase (GGT > 40 U/L) was found in at least half of these cases. Abnormal GGT concentrations were found in 14 of the men and 7 of the women. Serum ferritin was inversely associated with age in both sexes, however this reached significance only in women ($r = -0.27$; $P < 0.05$).

The mean energy intake of both men and women (7984 (s.d. = 3245) and 6979 (s.d. = 2219) kJ, respectively) did not meet 100, but was above 67, of the RDA (NRC, 1989). Thirty-two per cent of men and 26 of women had energy intakes less than two-thirds of the RDA. A mean daily protein intake of 1.1 (s.d. = 0.5) g/kg body weight for men and 1.0 (s.d. = 0.4) g/kg for women was assumed to indicate an adequate dietary intake (Young and Pellet, 1987). The ratio of animal to total protein intake was 0.63. The mean intakes of iron, vitamin C, folate and vitamin B_{12} were 9.1 (s.d. = 4.3) mg; 63 (s.d. = 74) mg; 7.8 (s.d. = 7.3) μg; and 223 (s.d. = 111) μg, respectively; no sex differences in intake were found. The wide inter-individual variation in vitamin B_{12} intakes (45–2225 of RDA for men; 85–1440 for women) resulted in extremely high mean intakes. The percentages of subjects with mean intake of less than 67 of the RDA for iron, vitamin C and folate are 34.4, 48.9 and 14.6, respectively. Only four subjects (all men) had mean vitamin B_{12} intakes less than 67 of the RDA.

The contribution of the five basic and the 'other' food groups to folate, vitamin B_{12} and iron intake is shown in Figures 1a–c. The protein-rich group was the main source of protein, vitamin B_{12}, iron and folate in the diet. Almost half (46.7) of the iron intake was supplied by the cereal and 'other' food groups. Of the 10 of subjects who reported taking dietary supplements, only two subjects were taking iron/folate supplements therefore differences in blood values between vitamin users and non-users were not calculated.

Less than a third of the men and less than a tenth of the

Table 1 Haematologic, folate and vitamin B_{12} concentrations: means (s.d.) and ranges

Parameter	*Men* $n = 88$[a]	*Women* $n = 99$[a]	*Total* $n = 187$
Haemoglobin (g/dL)	15.1 (1.8) (7.4–18.4)	13.2 (1.6) (8.9–18.6)	14.1 (1.9) (7.4–18.6)
RCC ($\times 10^{12}$/L)	5.07 (0.68) (2.92–6.57)	4.59 (0.64) (2.57–6.30)	4.82 (0.7) (2.57–6.57)
Haematocrit (%)	45 (5) (22–57)	40 (5) (27–55)	42 (6) (22–57)
MCV (fL)	89 (7) (72–110)	87 (11) (64–110)	88 (7) (64–110)
MCH (pg)	29.9 (2.8) (23.9–38.0)	29.0 (2.6) (20.0–34.8)	29.9 (2.8) (20.0–38.0)
MCHC (g/dL)	33.4 (1.0) (30.7–36.2)	33.1 (1.1) (30.3–35.9)	33.2 (1.0) (30.3–35.9)
WCC ($\times 10^9$/L)	7.8 (2.8) (0.1–21.5)	7.1 (2.2) (3.1–13.7)	7.5 (2.5) (0.1–21.5)
Platelets ($\times 10^9$/L)	264 (119) (104–1 150)	270 (78) (95–596)	268 (100) (95–1 150)
Serum ferritin (μg/L)	198 (337) (14–2 910)	105 (90) (10–570)	151 (268) (10–2 910)
Serum vitamin B_{12} (pg/mL)	449 (204) (161–1 019)	458 (233) (28–1 006)	478 (220) (28–1 019)
Serum folate (ng/mL)	5.0 (2.5) (0.5–16.9)	6.0 (4.0) (0.7–20.0)	5.5 (3.4) (0.5–20.0)
RBC folate (ng/mL)	261 (110) (49–772)	313 (160) (49–867)	288 (140) (49–867)

Abbreviations: RCC = red cell count; MCV = mean corpuscular volume; MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration; WCC = white cell count; RBC = red blood cell.
[a]Serum ferritin: n = 86(M), n = 96(F); serum vitamin B_{12} and folate: n = 83(M), n = 95(F); RBC folate: n = 85(M); n = 95(F).

Table 2 The prevalence of abnormal haematologic results and corresponding results of iron, folate and vitamin BZ_{12} status indicators

Parameter	*Men* $n = 88$[a]		*Women* $n = 99$[a]		*TOTAL* $n = 187$		*Abnormal range*
	n	%	*n*	%	*n*	%	
Haemoglobin	10	11.4	16	16.2	26	13.9	< 13 g/dL (M) < 12 g/dL (F)
MCV	10	11.5	14	14.4	24	13.0	< 81 fl
	25	28.7	8	8.2	33	17.9	> 93 fl (M) > 95 fl (F)
MCH	22	25.3	24	24.7	46	25.0	< 28 pg
MCHC	28	32.2	38	39.2	66	35.9	< 33 g/dL
WCC	4	4.5	4	4.1	8	4.3	$< 4 \times 10^9$/L
	5	5.7	5	5.2	10	5.4	$> 11 \times 10^9$/L
Serum ferritin	1	1.1	5	5.2	6	3.2	< 15 μg/L
	10	11.4	2	2.1	12	6.5	> 300 μg/L
Serum vitamin B_{12}	0	0	3	3.1	3	1.7	< 100 pg/mL
Serum folate	15	18.1	14	14.7	29	16.3	< 3 ng/mL
RBC folate	3	3.5	3	3.1	6	3.3	< 100 ng/mL

Abbreviations: MCV = mean corpuscular volume; MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration; WCC = white cell count; RBC = red blood cell.
[a]See footnote in Table 1.

women reported that they had consumed alcohol in the previous month. In the total group, the mean alcohol intake of women was significantly lower than that reported by men (0.3 (s.d. = 1.4) g/d *vs* 3.0 (s.d. = 7.4) g/d respectively, $P < 0.005$)). For both sexes, the wide variation in alcohol consumption within the sample is demonstrated by the large standard deviations and a median value of zero. The mean intake of alcohol consumers alone was 9.5 (s.d. = 10.7) g/d for men ($n = 30$) and 3.8 (s.d. = 3.1) g/d ($n = 9$) for women.

Discussion

The prevalence of anaemia found in this study (14) is of the same order of magnitude as that previously reported in this population (Jacobs *et al*, 1984); it is nevertheless higher than that reported in studies of elderly populations in Europe (Dirren *et al*, 1991; Löwik *et al*, 1992) and the United States (Dallman *et al*, 1984; Lynch *et al*, 1982) but considerably lower than in a study of elderly men in Ireland (Fogarty and Nolan, 1992).

Table 3 Individual haematological and biochemical results of subjects presenting with anaemia

Gender		*Hb (g/dL)*	*WCC ($\times 10_9$/L)*	*MCV (fL)*	*Serum ferritin (μg/L)*	*Serum Vit B_{12} (pg/mL)*	*RBC folate (ng/mL)*
Anaemia with haematinic deficiencies							
Men	1	**7.4**[a]	**12.8**	**76**	**14**	161	**59**
Women	2	**8.9**	7.1	**102**	**12**	208	**62**
	3	**8.9**	6.2	**105**	18	**60**	508
	4	**10.9**	4.8	84	68	**28**	159
	5	**11.0**	5.9	**78**	**13**	256	390
	6	**11.5**	4.0	88	**11**	105	149
	7	**11.8**	9.9	**95**	**310**	229	**49**
	8	**11.9**	5.2	78	**14**	607	336
Anaemia without haematinic deficiencies							
Men	9	**10.5**	5.2	**72**	29	162	195
	10	**11.4**	**3.4**	93	123	513	772
	11	**11.9**	5.0	87	67	521	139
	12	**12.2**	**3.4**	91	87	180	173
	13	**12.2**	9.3	75	132	280	149
	14	**12.3**	4.8	**105**	51	352	338
	15	**12.5**	7.9	**98**	**600**	193	100
	16	**12.5**	8.7	**95**	153	847	476
	17	**12.8**	8.6	89	168	376	275
Women	18	**9.8**	5.7	81	16	464	267
	19	**10.4**	6.7	**72**	76	155	—
	20	**10.6**	4.8	**97**	79	384	407
	21	**10.8**	6.9	**64**	257	—	—
	22	**11.0**	6.3	91	33	209	330
	23	**11.3**	7.7	88	239	348	383
	24	**11.6**	5.6	88	30	166	196
	25	**11.9**	4.9	90	100	322	328
	26	**11.9**	9.3	**96**	82	863	509

Abbreviations: Hb = haemoglobin; MCV = mean corpuscular volume; RBC = red blood cell; WCC = white cell count.
[a]Values in bold are outside normal range.

Table 4 Individual haematologic and biochemical results of subjects with raised serum ferritin concentrations

		Serum ferritin (μg/L)	*Hb (g/dL)*	*MCV (fL)*	*Serum Vit B_{12} (pg/mL)*	*RBC folate (ng/mL)*	*WCC ($\times 10_9$/L)*	*GGT (U/L)*
Men	1	**2910**[a]	15.5	**98**	553	342	4.0	**413**
	2	**1850**	16.1	**108**	839	333	5.0	**146**
	3	**777**	17.0	**97**	373	252	7.8	**94**
	4	**721**	13.4	**98**	191	205	7.3	9
	5	**610**	18.0	86	423	399	**21.5**	23
	6	**600**	**12.5**	**98**	193	100	7.9	**45**
	7	**570**	17.9	**94**	378	**97**	10.3	**102**
	8	**513**	15.5	**95**	658	191	6.7	30
	9	**460**	16.8	86	289	320	9.7	**116**
	10	**307**	15.5	**80**	459	181	5.6	12
Women	11	**328**	18.6	85	323	275	5.9	35
	12	**310**	11.8	95	229	**49**	9.9	**61**

Abbreviations: Hb = haemoglobin; MCV = mean corpuscular volume; RBC = red blood cell; WCC = white cell count; GGT = gamma-glutamyltransferase.
[a]Values in bold are outside the normal range.

In the present study, about a third of the anaemic subjects had haemopoeitic nutrient deficiencies, with iron deficiency (low serum ferritin) being the most common. Consistent with findings from studies of European (Fogarty and Nolan, 1992; Haller *et al*., 1991) and American (Sahyoun, 1992) elderly, a low prevalence of both vitamin B_{12} and folate deficiency was found. However, in the cited studies folate status was assessed using plasma concentrations; in this regard, subjects in the present study had a prevalence of folate deficiency similar to that reported for institutionalized or cognitively impaired elders (11 to 28) (Löwik *et al*., 1992; Spindler and Renvall, 1989; Infante-Rivard *et al*., 1986). Folate and vitamin B_{12} deficiency may result from low dietary intake, decreased absorption or chronic pharmacotherapy known to affect the metabolism of these vitamins, or a combination of these factors (Beal, 1980; Hoffman, 1993). Regarding inadequate dietary intake as a cause for anaemia, in most subjects the mean intakes of folate and vitamin B_{12} exceeded the RDA in the present study. No women had intakes of less than two-thirds of the RDA for vitamin B_{12} and only 8 had inadequate folate intakes. For men, an inadequate folate food intake was found in a fifth of subjects (21) whereas the prevalence of an inadequate vitamin B_{12} intake was low (4). Alcohol abuse is a further factor known to adversely affect folate nutriture (Jacobs *et al*, 1984; Unger and Johnson, 1974); in this regard, three subjects had macrocytosis without a deficiency of either of these vitamins.

Folate and vitamin B_{12} status, particularly in the elderly, is currently the subject of considerable debate, primarily

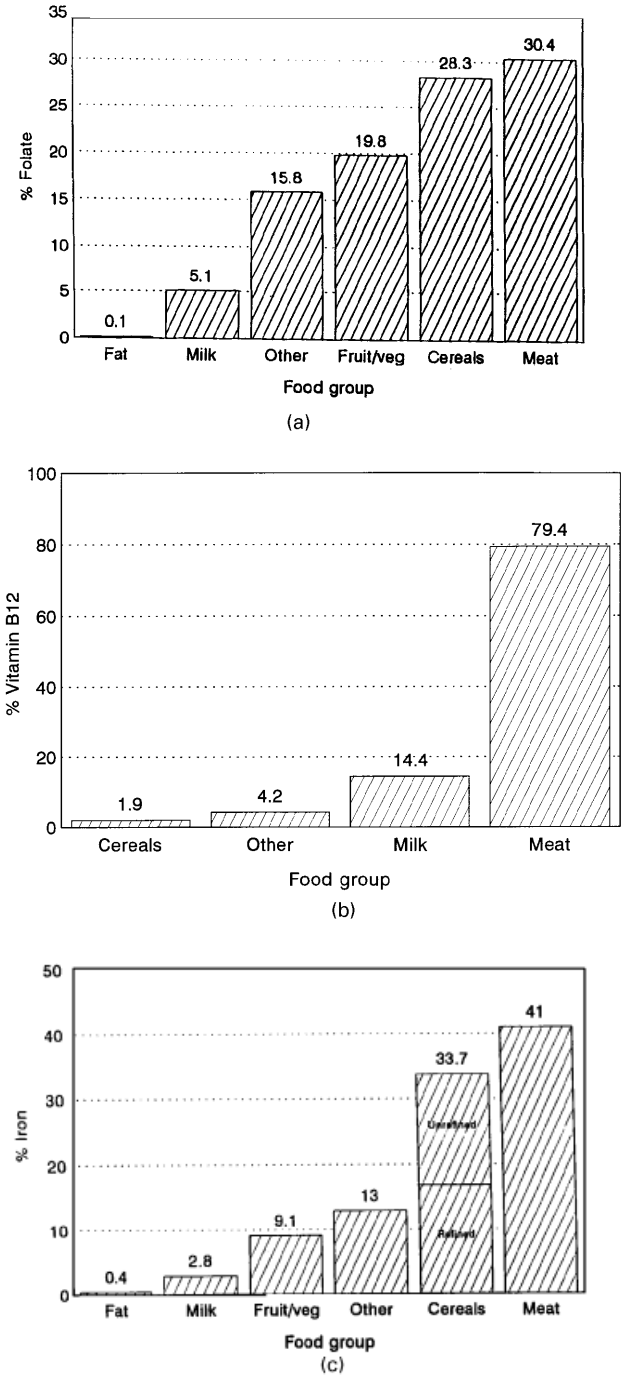

Figure 1 (a) Mean contribution of food groups to total folate intake; (b) Mean contribution of food groups to total vitamin B_{12} intake; (c) Mean contribution of food groups to total iron intake.

because refined biochemical techniques estimate the prevalence of tissue deficiency, without the presence of anaemia, to be higher than the prevalence detected by measuring serum or blood cell concentration of the vitamins (Joosten *et al*, 1993; Lindenbaum *et al*, 1994); such suboptimal status at the biochemical level has been associated with significant neuropsychiatric damage including impairment in cognitive function (Lindenbaum *et al*, 1988; Healton *et al*, 1991). Moreover, similar suboptimal status of both vitamins, together with vitamin B_6, has been associated with elevated serum homocysteine concentration (Stabler *et al*, 1988), the latter being increasingly accepted as an independent and major risk factor for coronary, peripheral and cerebrovascular disease (Clarke *et al*, 1991; Kang *et al*, 1992). The maintenance of optimal folate and vitamin B_{12} status in the elderly therefore promises potentially significant advantages which further studies will undoubtedly put in better perspective.

Iron deficiency anaemia was the most common deficiency in this study population, accounting for 63 of the subjects with anaemia associated with haematinic deficiencies. Although the mean iron intake was reasonably high (86 and 95 RDA for men and women, respectively), over a third of subjects (34.4) had intakes less than two-thirds of the RDA, indicating a wide between-subject variation. The lower iron intakes in women partly explains their higher prevalence of iron deficiency, as compared to the men. Despite a higher energy intake, subjects in the present study had 16–33 lower iron intakes than American elderly sampled in the NHANES II study (Lynch *et al*, 1982). However, the availability of dietary iron for absorption is an important factor in determining nutritional adequacy, which is enhanced by ascorbic acid and heme iron in the form of meat. Almost half of the subjects (48.9) had an inadequate vitamin C intake. However, the main source of vitamin B_{12}, folate and iron in the present study was the protein-rich group, namely meat, fish, chicken, eggs, legumes, nuts and peanut butter. In addition, the ratio of animal to total protein intake (0.63) indicates that the main sources of protein in the diet were of animal origin, which provides readily absorbable heme-iron.

The findings of this study are in agreement with previous findings in the South African coloured population (Jacobs *et al*, 1984), in whom all reported cases with microcytic, hypochromic anaemia were associated with occult gastrointestinal bleeding, primarily due to underlying gastrointestinal malignancy. It is important that elderly people presenting with iron deficiency anaemia be investigated for treatable gastro-intestinal pathology (Croker and Beynon, 1981; Jacobs, 1982). In this regard, the cut-off points of serum ferritin for the diagnosis of iron deficiency have recently been questioned, since iron deficient erythropoiesis can occur in elderly patients with ferritin levels up to 75 μg/L; a cut-off point higher than that of younger adults may therefore be more relevant for use in the elderly (Holyoake *et al*, 1993). In unison with these proposals, it is of interest that in the present study serum ferritin levels below 15μg/l were uncommon in men and found only in 5 of the women. Serum ferritin is an acute phase protein and is typically elevated in infection, inflammation and malignancy (Joosten *et al*, 1993; Bothwell *et al*, 1979; Worwood, 1986). When iron deficiency therefore coexists with chronic disease serum ferritin may be falsely raised and iron deficiency may remain undiagnosed.

A high prevalence of raised serum ferritin was found, particularly in the men. Although serum ferritin and bone marrow iron stores have been shown to increase with age (Lynch *et al*, 1982) and in women they may double after the age of 45 y due to menopause, (Macphail *et al*, 1981), ageing per se has not been found to result in marked iron accumulation in the body (Munro, 1992; Miolman *et al*, 1986). Iron overload has been reported in 22 of an elderly population in Glasgow (Holyoake *et al*, 1993). Further, patients with idiopathic haemochromatosis are known to have very high serum ferritin concentrations (500–5000 μg/L) (Worwood, 1986). Eight of the men but none of the women in the present study had concentrations in that range, the two highest concentrations being 1850 and 2910 μg/L. Meyer and co-workers (1990) found that only

0.8 of a sample of Caucasian men over the age of 40 y (14.8 of those with iron overload) were regarded as homozygous for the iron-binding gene which causes idiopathic haemochromatosis. Excessive alcohol consumption is associated with hyperferritinaemia both in idiopathic haemochromatosis and in the absence of this genetic disorder (Bothwell *et al*, 1979; Friedman *et al*, 1990). The mechanism through which alcohol causes or enhances hyperferritinaemia is not clear. Evidence indicates that the intake of excessive quantities of home brewed, fermented beer by black men in sub-Saharan Africa, overrides the regulation of iron absorption by the upper gastro-intestinal mucosa and leads to oral iron overload (Friedman *et al*, 1990; Gordeuk *et al*, 1986). Although the population sampled in the present study do not consume home brewed beer with a high iron content, the results suggest that alcohol may have been a major factor in hyperferritinaemia since iron overload was frequently accompanied by macrocytosis (58) and to a lesser degree by folate deficiency (17). Alcohol is known to have a profound effect on folate metabolism, and is associated with erythropoiesis (Bothwell *et al*, 1979), which, together with the liver damage caused by excessive alcohol consumption and the increased absorption of non-haem iron (Hallberg *et al*, 1982), may contribute to iron overload. The high prevalence of increased serum gamma-glutamyltransferase (59) in subjects with raised serum ferritin concentrations provides additional support for the postulate that alcohol may have contributed significantly to the high serum ferritin concentrations found in some subjects. These findings indicate that alcohol intake was probably under-reported, particularly in the men. The need to validate reported alcohol intake in this age group has been highlighted by a study of Mowat *et al* (1992). The extent to which haemoglobinopathies and blood transfusion may have contributed to iron overload was not determined in the present study.

Concern for iron deficiency and iron deficiency anaemia frequently overshadows that for iron overload, despite the documented prevalence of the latter in 6.8 of the adult (20–74 y of age) population of the United States (Expert Scientific Working Group, 1985). Whereas optimal iron status is accepted to be of considerable importance for normal neurological (Beard *et al*, 1993) and immune (Chandra, 1992) function, recent findings suggest an association between iron overload and ischaemic heart disease (Salonen *et al*, 1992) as well as cancer (Weinberg, 1992). Although the evidence regarding these associations remains conflicting (McCord, 1991; Korn and Graubard, 1991) it underscores the care that needs to be exercised for the correct assessment of iron status in the population at large and in the elderly in particular.

In the present study the anaemia in most subjects (69) was not associated with haematinic deficiencies. The cause of their anaemia is not clear. Similar findings have been reported in elderly populations in the USA (Lipschitz *et al*, 1981) and have been attributed to an overall reduction in haematopoietic reserve; the latter concept was based on the high prevalence (30) of leucopenia ($WCC < 4 \times 10^9/L$) found in the elderly who were anaemic. In the present study however, only two of the 26 anaemic subjects had leucopenia; reduced haemopoietic reserves are therefore unlikely to have been a major cause of the anaemia. Moreover, the prevalence of an increased white blood cell count indicative of infection in the subjects was low (5) and was similar to previously reported data for this population (Jacobs *et al*, 1984); only one of the subjects with elevated white cell counts was found to be anaemic. Although underlying chronic disease has been reported to be the main cause of anaemia in elderly Americans (Dallman *et al*, 1984), the prevalence of such disease or malignancy was not determined in the present study.

Finally, it is interesting that microcytosis was found to be more common that low serum ferritin concentrations. This may indicate thalassaemia, sideroblastic anaemia or falsely raised ferritin concentrations due to disease. The existence of α-thalassaemia in the South African coloured population has previously been established (Bird *et al*, 1987; Rousseau *et al*, 1985), however the prevalence of α-thalassaemia and sideroblastic anaemia was not determined in the present study.

Conclusions

Older coloured South Africans, particularly women, should be encouraged to eat diets with a high nutrient density and to consume adequate amounts of foods high in iron, folate and vitamin B_{12}. The apparent excessive alcohol consumption in the men warrants further investigation.

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