

The fat and the thin — a survey of nutritional status and disease patterns among urbanized Black South Africans

S. J. D. O'KEEFE, DUDU THUSI, SHIRLEY EPSTEIN

Summary

The nutritional status of and disease patterns in 449 healthy and 803 hospitalized urbanized Blacks in Durban were surveyed. While unemployed males were generally less fat than controls, obesity (i.e. weight 40% over that expected) was extremely common among female factory (33%) and female hospital 'domestic' (65%) employees. Undernutrition was significantly more common among patients and more marked in males, 82% having significantly reduced fat stores. Disease patterns were similar in malnourished male and female patients, with infective and respiratory diseases predominating. However, the pattern was different in overweight male and female patients, non-ischaemic cardiovascular diseases, particularly hypertension, predominating. The most common cause of death in males was respiratory disease, and in females cardiovascular disease. Overall, malnutrition was most common in the subgroup ($N = 212$) of patients who died.

The results confirm the known associations between undernutrition and increased susceptibility to infection and mortality, and also between overnutrition and hypertensive cardiovascular disease. The observation that malnutrition and obesity can coexist within rapidly urbanized communities stresses the need for concurrent education on nutrition. The high incidence of 'hospital malnutrition' observed emphasizes the need for nutritional support in acutely ill patients.

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Malnutrition is a fact of life for most peoples of rural Africa. Numerous workers have documented the strong association between chronic starvation, infective disease and the consequent elevated mortality rates.¹⁻⁴ The pattern of disease among these people is characterized by the dominance of infective diseases and the absence of the so-called 'westernized diseases' such as myocardial infarction and degenerative and neoplastic diseases.

Common to most Third World countries is a rapid urbanization process. This has resulted in dramatic changes in lifestyle and socio-economic factors. In South Africa only 12,6% of the

total Black (African) population was urbanized in 1911. This figure had risen to 28% by 1960 and is predicted to reach 75% by the year 2000. Recent evidence has shown a change in nutritional status in females from chronic malnutrition to obesity, and the appearance of a more westernized disease pattern.⁵ Myocardial infarction now accounts for 12% of cardiac-related diseases in urbanized Blacks in Johannesburg;⁵ this disease was previously virtually unknown. Hypertension is now common among urbanized (as opposed to rural) Blacks.⁶⁻⁸

This study was designed to assess the effect of urbanization on the nutritional status of and disease patterns in Zulu patients admitted mainly from urban areas to medical wards in Durban. It was hoped that information gained would help further the understanding of the complex interrelationships between nutrition and disease.

Hospital background

The study was conducted in a major general teaching hospital (King Edward VIII Hospital, Durban) subserving an estimated Black population of 500 000. The majority of patients are admitted from urbanized communities via a combined casualty/outpatient department with an attendance rate of over 2 000 patients per day. The total number of beds for these patients is 2 099, with the occupancy rate varying between 90% and 104%. Of these, 430 are general medical beds (250 for males, 180 for females). Bed space is always in short supply, necessitating admission of only the severely ill and incapacitated. Discharge home or to a convalescent hospital (1 000 beds) is expedited, the average length of stay in medical wards being only 5 days. An admission mortality of 15% has been demonstrated, while 42% of the patients are transferred to a convalescent hospital and 43% are discharged directly home.

Patients and methods

Between the months of April and December 1981 a randomly selected sample of 803 patients admitted as emergency cases to one medical ward were studied.

Assessment of nutritional status

Assessments were based on standardized anthropometric techniques as described by Jelliffe.⁹ The techniques enable loss or gain of total body weight (weight for height measurement), body fat stores (triceps skinfold thicknesses) and muscle bulk (midarm muscle circumference and area¹⁰) to be estimated. Measurement of plasma albumin concentrations was used to provide additional evidence of protein depletion.⁹ The standards quoted by Jelliffe will hereafter be termed 'international standards'.

Routine laboratory measurements of haemoglobin, total white cell count, erythrocyte sedimentation rate and plasma albumin concentration were also documented.

Gastro-intestinal and Liver Units, Department of Medicine, University of Natal and King Edward VIII Hospital, Durban
S. J. D. O'KEEFE, M.D., M.S.C., M.R.C.P.
DUDU THUSI, R.N.
SHIRLEY EPSTEIN, DIP. MED. TECH.

Date received: 18 May 1982.

Reprint requests to: Dr S. J. D. O'Keefe, Gastro-intestinal Unit, Department of Medicine, University of Natal, PO Box 17039, Congella, 4013 RSA.

Controls

Various subgroups from the healthy Zulu population were sampled in order to obtain the best estimates for local control anthropometrics. The data collected are summarized in Table I. A common pattern of slimness in men and fatness in women was apparent, extreme values being detected in unemployed males (undernutrition) and female hospital employees (overnutrition). It was therefore decided to choose age-matched factory workers as our controls as they appeared to be middle-of-the-road as regards socio-economic and nutritional status. The factories all supplied either free or subsidized lunches. The incomes of all male workers were above the supplemented living level (i.e. the officially accepted figure which 'enables a family to maintain a comfortable standard of living'). The high incidence of obesity among female hospital staff is undoubtedly a result of overeating, since a large proportion work in the hospital kitchen distributing food to patients. The relatively poor nutritional status of the unemployed reflects their generally poor socio-economic background.

Mean values for the patient group were compared with those of the control group by analysis of variance. Significance was taken as being $P < 0.05$. Disease patterns were analysed by the chi-squared method.

Results

Nutritional status

The population samples. Table I summarizes the anthropometric measurements of the population groups. By comparison with international standards, it is apparent that while mean values for young Black students were not significantly different from standard, on average males were thinner and women fatter than normal. The effect of age suggests that men become heavier primarily owing to an increase in muscle bulk (i.e. as indicated by arm muscle area), while women become considerably fatter (as shown by triceps skinfold measurements). The mean weight of the control group was 110% of the international standard for men, while that for females was 126% (89% were overweight, with 33% weighing over 140% of normal), with the males and females having triceps skinfold thicknesses of 72% and 134% of the international standard respectively (Table II). Obesity was almost universal in the female hospital (domestic) employees, 96% having body weights and triceps skinfold thicknesses greater than the international standard and 91% exceeding the mean weight for the control group. Sixty-five per cent were severely obese, weighing 40% more than expected for height.

Hospitalized patients. Both male and female patients were significantly malnourished according to the international standard (Table II) and compared with the controls (Table III). Depletion of body stores of fat was most apparent in males (Fig. 1, right), 82% having triceps skinfold thicknesses below 60% of the international standard, i.e. the level commonly taken in westernized hospitals to indicate significant malnutrition (Table IV).¹¹⁻¹³ In comparison, 55% of the female patients had a triceps skinfold thickness below this level. On the other hand, 33% of females and only 12% of males were considered overweight on admission. Twelve per cent of the female patients were severely obese (i.e. more than 40% overweight) (Fig. 1, left). Derived estimates of muscle bulk were less severely affected; in males the mean value for arm muscle area was 93% of that of the international standard, while in females the corresponding value was 80% (Table II). However, low plasma protein concentrations were common, most patients having albumin concentrations below the normal laboratory range of 35-50 g/dl. Sixty-eight per cent of the male patients and 61% of the female patients had plasma albumin concentrations below 35 g/dl, while 20% of the female patients and 7% of the males had severely depressed levels, below 20 g/dl.

TABLE I. NUTRITIONAL STATUS (MEAN VALUES \pm SD)

	Age (yrs)	Weight (kg)	Height (cm)	% ideal weight	Triceps skinfold thickness (mm)	Mid-arm circumference (cm)	Arm muscle circumference (cm)	Arm muscle area (cm ²)
Patients†								
Male (N = 550)	42 \pm 16	55 \pm 12*	171 \pm 8	82 \pm 17	6.0 \pm 2*	23.3 \pm 4*	25	52
Female (N = 253)	41 \pm 19	52 \pm 21*	161 \pm 7	91 \pm 23	14.4 \pm 11*	23.9 \pm 5*	22	40
Fatalities								
Male (N = 134)	48 \pm 12	49 \pm 11*	170 \pm 7	69 \pm 18	5.0 \pm 2.1*	21 \pm 4.2*	21	34
Female (N = 78)	49 \pm 15	48 \pm 12*	160 \pm 6	83 \pm 25	7.8 \pm 5*	22.4 \pm 5*	21	35
International standards								
Male	42	67.3	171	100	12.5	29.3	25.3	56
Female	41	56.9	161	100	16.5	28.5	23.2	50
Controls (factory employees)								
Male (N = 94)	41 \pm 11	73 \pm 13	170 \pm 7	110	9 \pm 4	28 \pm 3	27.5	61
Female (N = 81)	31 \pm 8	73 \pm 14	162 \pm 5	126	22.1 \pm 11	29 \pm 3.4	22.5	42
Students								
Male (N = 57)	21 \pm 2	64 \pm 8*	175 \pm 6	91	6.8 \pm 2*	25 \pm 2*	26	55.5
Female (N = 69)	21 \pm 2	60 \pm 10*	162 \pm 5	104	15.6 \pm 6*	25 \pm 2*	22.4	41
Female hospital employees (domestic) (N = 56)	38 \pm 9	84 \pm 15*	163 \pm 5	145	31 \pm 7*	33 \pm 4*	22	40
Male unemployed (N = 92)	38 \pm 9	65 \pm 11*	171 \pm 6	97	7 \pm 3*	27 \pm 3*	27	60

* $P < 0.05$ as compared with controls.

† Haemoglobin concentration (g/dl): male patients — 12.4 \pm 3 (normal 14-18), females — 10.7 \pm 3 (normal 12-16); white cell count ($\times 10^9/\mu\text{l}$): males — 9.6 \pm 5, females — 8.9 \pm 4 (normal 3.5-11); erythrocyte sedimentation rate (mm/1st h): males — 57 \pm 44, females 61 \pm 47 (normal < 5); albumin (g/dl): males — 31 \pm 8, females — 30 \pm 9 (normal 35-50).

TABLE II. MEAN VALUES EXPRESSED AS PERCENTAGES OF INTERNATIONAL STANDARDS

Group	Weight*	Triceps skinfold thickness	Mid-arm circumference	Arm muscle circumference	Arm muscle area
Factory workers (controls)					
Male	110	72	96	109	109
Female	125	134	102	88	70
Students					
Male	91	54	85	103	73
Female	104	95	88	97	80
Female domestics	145	188	116	95	80
Male unemployed	97	56	92	109	109
Patients					
Male	82	48	80	98	93
Female	91	87	84	95	80
Fatalities					
Male	73	40	72	81	61
Female	84	47	81	91	70

*Average frame size.

TABLE III. MEAN VALUES EXPRESSED AS PERCENTAGES OF THE CONTROL VALUES

Group	Weight	Triceps skinfold thickness	Mid-arm circumference	Arm muscle circumference	Arm muscle area
Male unemployed	89	78	96	98	98
Female domestics	115	140	113	98	95
Patients					
Male	75	67	83	91	85
Female	71	65	82	98	95
Fatalities					
Male	67	55	75	75	56
Female	66	35	79	93	98

TABLE IV. PERCENTAGES OF PATIENTS WITH PARAMETERS > 100%, < 80% and < 60% OF INTERNATIONAL STANDARDS

	> 100%	< 80%	< 60%
Weight			
Male	14	53	8
Female	35	57	19
Ideal weight			
Male	12	45	6
Female	33	33	4
Triceps skinfold thickness			
Male	3	94	82
Female	22	71	55
Mid-arm circumference			
Male	5	44	3
Female	15	43	3

Patients who died. Malnutrition was more common in this subgroup. Almost all males who died (97%) had triceps skinfold thicknesses below 60% of the international standard, while in 72% of the females similar depletions were present. Unlike the situation found when the total patient group was analysed, significant reductions in muscle bulk of between 30% and 40% were also detected in this subgroup, suggesting depletion of both energy and protein stores (Table II).

Blood tests. The majority of patients had mild anaemia and a mildly elevated white cell count. The erythrocyte sedimentation rate was usually markedly elevated (mean 57-61 mm/1st h), 20% of patients having values > 100 mm.

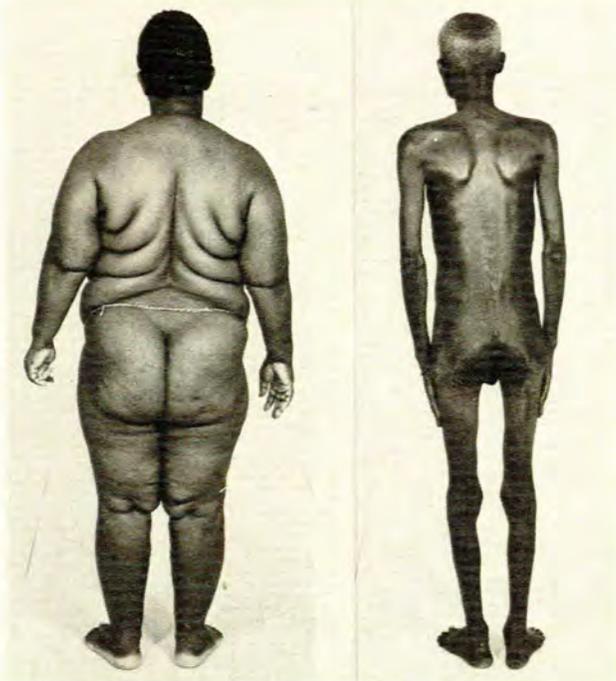


Fig. 1. The fat and the thin — left: female patient with hypertension; right: male patient with pulmonary tuberculosis.

Disease patterns (Table V)

Total patient population

The most common diagnosis in males was pneumonia due to pneumococcal, *Haemophilus*, *Klebsiella* and tubercle bacillus infections; 35% of those admitted suffered from respiratory disease, mostly associated with or produced by bacterial infections. Thirty-nine per cent of male and 34% of female patients had acute infections on admission. Immunologically confirmed virus disease was uncommon. The high incidence of tuberculosis within the Black community was highlighted by the finding that 11-12% of all patients had the disease on admission. The most common forms of cardiac disease encountered were congestive cardiac failure due to cardiomyopathy or hypertension (41%), hypertension (34%) and complications of rheumatic valvular disease (14%). Liver diseases included cirrhosis and portal hypertension of mixed aetiology (hepatitis B virus, alcohol, siderosis and toxins¹⁴), hepatitis due to a virus, alcohol or herbal toxins, primary hepatocellular carcinomas (hepatomas) and amoebic liver abscesses. Nervous system disorders included epilepsy (24%), cerebrovascular accidents related to trauma and hypertension (20%), unexplained hemiplegias (16%), bacterial meningitis (10%) and toxic confusional states (16%). Gastro-intestinal disorders were most commonly diarrhoeas of bacterial, amoebic or herbal toxin aetiology, and chronic pancreatic disease (associated with alcohol abuse) was not uncommon. Diabetes was the most common endocrine disorder, often associated with chronic pancreatitis in males, and carcinoma of the lung, hepatomas and lymphomas were the most common neoplastic diseases. The pattern in women was different, with a relatively lower incidence of respiratory ailments and an increased incidence of cardiovascular, haematological and renal disorders. Macrocytic anaemias were particularly common in young women (40% of total anaemias seen).

Patients who died

Data were obtained on all 212 patients who died in the ward during the survey period. The mortality rate was higher among males than females (17% and 10% respectively). Among males the most common diseases were again those involving the respiratory system (26%), these usually being infective in origin. In females the pattern was quite different, with marked increases in the incidences of cardiovascular (35%) and central nervous system (24%) disorders, and a relatively low incidence of respiratory disorders (6%). In particular, hypertensive cerebrovascular accidents were a common cause of death. On the other hand, myocardial ischaemia was only present in 2 of the females and in none of the males who died.

Severely malnourished patients

Severe malnutrition was arbitrarily defined as a reduction in triceps skinfold thicknesses to below 32% of the international standard in men (i.e. < 4 mm), and less than 40% in female patients (i.e. < 7 mm). While the disease pattern of malnourished men was similar to that of the total patient group, that of malnourished female patients was significantly different from that of the total female group. The pattern here becomes almost indistinguishable from that of the men, with the respiratory system taking over from the cardiovascular system as being most commonly involved. Conversely, cardiovascular and nervous system disorders were less commonly observed. A peak incidence of tuberculosis (20%) was evident in both males and females. Gastro-intestinal and liver disorders were more common. Haematological abnormalities were common among female patients, patients usually presenting with a megaloblastic disorder. Neo-

TABLE V. BREAKDOWN OF OCCURRENCE OF DISEASE (%)

	Infections	Liver	Nervous system	CVS	Respiratory	Gastro-intestinal	Endocrine	Renal	Haematological	Neoplastic	TB
Total patients											
Male (N = 542)	39	15	16	17	35	7	5	2	4	6	12
Female (N = 243)	34	15	12	24	22	7	8	9	10	3	11
Malnourished patients											
Male (TSF < 4 mm) (N = 136)	42	20	4	8	35	11	7	<1	2	10	20
Female (TSF < 7 mm) (N = 78)	42	18	8	14	30	8	5	4	13	4	19
Fatalities											
Male (N = 134)	27	19	16	18	26	7	7	6	6	8	8
Female (N = 78)	15	19	24	35	6	5	6	6	5	6	0
Overweight patients											
Male (N = 66)	18	12	23	38	18	1	12	1	1	3	4
Female (N = 81)	19	15	15	35	14	3	10	10	11	4	4

TSF = triceps skinfold thickness; CVS = cardiovascular system; TB = tuberculosis. Comparison of disease patterns within the different subgroups of patients studied by chi-squared analysis: malnourished males v. overweight males, $P < 0.0005$; malnourished females v. overweight females, $P < 0.0005$; malnourished males v. male fatalities, $P < 0.05$; malnourished females v. female fatalities, $P < 0.005$; overweight males v. male fatalities, $P < 0.0005$; overweight females v. female fatalities, $P = NS$.

plastic diseases, a group often associated with wasting in developed countries, were relatively uncommon in all groups of patients studied.

Overweight patients

Females. Eighty-one patients (33%) were overweight by international standards. Breakdown of the disease pattern demonstrated a pattern remarkably similar to that in the women who died, with a high incidence of cardiovascular diseases (35%) and a low incidence of infective (19%) and respiratory (14%) diseases. Hypertensive cardiac disease was more common here than in the total group; straightforward hypertension accounted for 42% of the cardiovascular diseases seen.

Males. Sixty-six patients (i.e. 12%) were overweight. The disease pattern was quite different from that of the total male group (in particular that of the malnourished male patients), with a predominance of non-ischaemic cardiovascular as opposed to respiratory disorders. The pattern thus approximated that of the female patients, particularly the overweight females.

Discussion

This study has shown significant differences in the nutritional status of various samples of the population studied. It was encouraging to find that students appeared to be well-nourished. However, the propensity of the urbanized Black female to become obese is alarming, and may account for the differences in disease patterns noted between men and women. Hospitalized patients weighed less and had less body fat than selected controls and as listed for the international standard. However, while 82% of the male and 55% of the female patients had significant losses of fat stores, 33% of the female patients were overweight on admission. When the disease pattern of the latter group was analysed, a predominance of hypertensive and cardiomyopathic cardiovascular diseases was found, this differing significantly from the pattern in malnourished male and female patients, who most commonly suffered from infective and respiratory disorders. The importance of this observation is that these cardiovascular diseases were the most common cause of death in women. The association between obesity and hypertension is well recognized. Sever *et al.*⁷ noted a strong correlation between body fatness and arterial blood pressure in the urbanized Black South African (their study covered Xhosa tribal groups while ours was on Zulus). However, Seedat *et al.* have demonstrated a similar trend of increased incidences of hypertension among urban⁶ as opposed to rural⁸ Zulus, this being more marked in women. What is surprising is the apparent lack of association between severe obesity and ischaemic heart disease in the urban Black Zulu female. While evidence of an increased prevalence of myocardial infarction has been observed at autopsy in urbanized Blacks in Johannesburg,⁵ the rate is still only 2% of that of the White population.¹⁵ This provides further evidence for a non-dietary environmental (e.g. smoking) or genetic aetiology of ischaemic heart disease.^{16,17}

The sharp division between the nutritional status of sick patients and that of the normal population has also been found in westernized countries. For example, 45% of patients in general medical and surgical wards in the USA were malnourished,^{11,12} with similar figures for patients with liver disease in the UK.¹³ The explanation for the association between disease and malnutrition is complex. Starvation lowers host defence,²⁻⁴ so that malnourished people are more prone to infections.¹ However, acute illness itself results in decreased appetite and protein catabolism and finally weight loss. Combination of the above two effects can clearly result in a vicious circle culminating in high fatality rates. It is not clear from our study whether a higher

percentage of our hospital patients were derived from the more malnourished sections of the population, e.g. the unemployed and low socio-economic groups, or whether their malnutrition was the consequence of frequent or prolonged illnesses.

Obesity is well accepted in Black African culture, and is indeed often considered a sign of health and prosperity. Feeding the family is entirely the woman's duty. The close proximity to food results in overeating and obesity (as shown by our hospital 'domestic' worker group), and hence the habit is going to be very difficult to break. However, it is possible to change such habits by mass education methods via the media, as evidenced by the recent reversal of the trend towards bottle- as opposed to breast-feeding of infants.

Malnutrition can be treated while the patient is in hospital. Clear records of the simple anthropometric measurements made in the present study should be used to diagnose and monitor nutritional status. Failure of a patient to take a normal diet should be investigated. In the presence of an intact gastrointestinal tract, nasogastric feeding or 'enteral hyperalimentation' should be tried. Should this approach fail, intravenous hyperalimentation should be mandatory. In this way, nutritional support should go hand-in-hand with drug therapy in the management of sick, malnourished patients. Only this approach can interrupt the vicious cycle of malnutrition and disease. The cost involved is not prohibitive when compared to that of drugs in current use, even in developing countries. Moreover, since malnutrition and mortality have been shown in this and in previous articles¹³ to be associated, the probable reduction in mortality would improve the cost-effectiveness of modern hospital treatment.

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REFERENCES

1. Scrimshaw NS. Protein deficiency and infective disease. In: Munro HN, Allison JB, eds. *Mammalian Protein Metabolism*, vol. II. New York and London: Academic Press, 1964.
2. José DG, Good RA. Immune resistance and malnutrition. *Lancet* 1972; **i**: 314.
3. Faulk WP, Demayer EM, Davies AJS. Some effects of malnutrition on the immune response in man. *Am J Clin Nutr* 1974; **27**: 638.
4. Smythe PM, Schonland M, Breton-Stiles CG *et al.* Thymolymphatic deficiency and depression of cell-mediated immunity in protein calorie malnutrition. *Lancet* 1971; **ii**: 939-943.
5. Isaacson C. The changing pattern of heart disease in South African Blacks. *S Afr Med J* 1977; **52**: 793-798.
6. Seedat YK, Seedat MA, Nkomo MN. The prevalence of hypertension in the urban Zulu. *S Afr Med J* 1978; **53**: 923-927.
7. Sever PS, Gordon D, Peart WS *et al.* Blood pressure and its correlates in urban and tribal Africans. *Lancet* 1981; **ii**: 60-64.
8. Seedat YK, Hackland DBT, Mponshane J. The prevalence of hypertension in rural Zulus. *S Afr Med J* 1981; **60**: 7-10.
9. Jelliffe DB. *Assessment of the Nutritional Status of a Community* (World Health Organization Monograph Series, No. 53). Geneva: WHO, 1966.
10. Grant A. *Nutritional Assessment Guidelines*. California: Cutter Medical, 1979.
11. Bistran BR, Blackburn GL, Vitale J *et al.* Prevalence of malnutrition in general medical patients. *JAMA* 1976; **235**: 1567-1570.
12. Bistran BR, Blackburn GL, Hallowell E *et al.* Protein status of general surgical patients. *JAMA* 1974; **230**: 858-860.
13. O'Keefe SJD, El Zayadi AR, Carraher TE, Davis M, Williams R. Malnutrition and immuno-incompetence in patients with liver disease. *Lancet* 1980; **ii**: 615-617.
14. O'Keefe SJD, Simjee A, Seedat YK. Clinical presentation and biochemical abnormalities in Black (Zulu) patients with cirrhosis in Durban. *S Afr Med J* 1982; **61**: 775-778.
15. Walker ARP. Can expectation of life in Western populations be increased by changes in diet and manner of life? Part II. *S Afr Med J* 1969; **43**: 768-775.
16. Walker ARP. Nutritional, biochemical and other studies on South African populations. *S Afr Med J* 1966; **40**: 814-852.
17. Higginson J, Pepler WJ. Fat intake, serum cholesterol concentration, and atherosclerosis in the South African Bantu. Part II: Atherosclerosis and coronary artery disease. *J Clin Invest* 1954; **33**: 1366-1371.