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NUTRITIONAL STATUS OF ZAMBIAN POPULATION GROUPS AND ZAMBIAN PATIENTS WITH HIV-ASSOCIATED DISEASE

BY

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STATEMENT

I hereby certify that this study is entirely the result of my individual effort. The various sources I am indebted too, I have acknowledged in the text and in my references.

DECLARATION

I hereby do declare that the work presented in this study for the M Med Degree (Surgery) has not been presented wholly or in part for any other degree and is not currently being submitted for any other degree.

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ABSTRACT

A study aimed at finding whether there are significant differences in the nutritional status of Zambian controls compared with AIDS and PGL patients was undertaken at the University Teaching Hospital, Lusaka and Saint Francis Hospital, Katete, respectively.

A total of 149 Zambians were examined and their measurements of weigh, height, midarm circumference and triceps skinfold thickness were recorded. Blood samples were analysed for HIV antibodies, total serum proteins and albumin. At the University Teaching Hospital (UTH), 27 patients were compared with 46 controls. The 27 patients consisted of 11 AIDS patients and 16 PGL patients. The controls consisted of 16 medical controls and 30 clinically health Zambian controls. At Saint Francis Hospital (SFH) 15 were AIDS patients, 30 medical controls and 30 casualty controls.

The mean ages in years and ranges (UTH); AIDS patients 39.6 years (24-70), PGL 27.8 years (19-30), medical controls 39.0 years (24-70), and casualty controls 27.7 years (18-60). The mean weights in kilograms and their ranges (UTH); AIDS patients 57.5 kg (43.1-68), PGL 57.7 (38-81), and casualty controls 59.6 (49-79). The heights and ranges in centimetres (UTH); AIDS patients 168.6 cms (150-179), PGL 164.3 cms (148-189), medical controls 168 cms (161-185) and casualty controls 167.7 cms (159-180).

The mean ages and ranges in years (SFH); AIDS patients 33.3 (24-56), medical controls 41.4 years (19-70) and casualty controls 31.7 years (18-65). Mean weights and ranges in kilograms (SFH); AIDS patients 53.7 kg (45-66), medical controls 48.7 kg (40.3-66.5) and casualty controls 58.1 kg (44-74). Mean heights and ranges in centimetres (SFH); AIDS patients 166 cms (150-184), medical controls 160 cms (150-171) and casualty controls 161.6 cms (151-177).

Comparison between the UTH patients versus the UTH controls showed no statistical significant differences in the midarm circumference, triceps skinfold thickness, total serum protein and albumin levels.

Comparisons were also made between the UTH patients and SFH patients and no significant findings were observed in the midarm circumference, triceps skinfold thickness, total serum protein and albumin levels. Finally the comparison between HIV positivity between the UTH casualty controls versus SFH casualty controls showed no significant difference statistically ($p = 0.06$). This study shows results similar to those obtained in previous studies among Zambians.

NUTRITIONAL STATUS OF ZAMBIAN POPULATION GROUPS

DEFINITION OF AIDS

The Acquired Immunodeficiency of Syndrome (AIDS) was defined by the Centres for Disease Control Surveillance as a disease at least moderately predicitve of a defect in cell mediated immunity occuring in a person with no known cause of diminished resistance to that disease (1).

THE HUMAN IMMUNODEFICIENCY VIRUS

The acquired immune deficiency syndrome is caused by a retrovirus now called the human immunodeficiency virus (HIV) (2). It was first identified in 1983 by Montagnier et al in France and called lymphademopathy associated virus (LAV) (3).

Previously, the first human retrovirus, called the T cell leukaemia virus type 1 (HTLV-I) had been isolated by Gallo et al in 1980 from a patient suffering from adult T cell leukaemia (4).

In 1982 Gallo and co-workers further isolated a second human retrovirus (HTLV-II) from a patient suffering from hairy cell leukaemia (5). Meanwhile, in 1981 Siegel et al described a new disease later called the acquired immunodeficiency syndrome, in young homosexual men (6). But it was Barre-Sinousai, Chermann, Montagnier et al (1983) who first published the isolation of a non-transforming retrovirus which they called the lymphadenopathy associated virus (LAV) (3). This was different from both HTLV-I and HTLVII. In 1984 Gallo et al also identified a retrovirus in patients with AIDS and with the lymphadenopathy syndrome, and named it HTLV-III (7). In January 1985 the nucleotide sequence of the AIDS virus genome was established independently at the Pasteur Institute and at the National Cancer Institute. The finding revealed similarities in the isolates. In 1985 the International Committee of Taxonomy of Viruses renamed LAV and HTLV-III as the Human Immunodeficiency Virus (HIV) (2). This virus preferentially infects T helper cells and alters their functions. T helper lymphocytes direct the processes of cell mediated immunity and also influence antibody production by B lymphocytes (7). An HIV infected person may not show overt symptoms of AIDs for a period ranging from 5 months to at least 5 years. Transmission is believed to be by the use of needles and syringes in drug addicts and possibly in urine, tears and breast feeding (9,10,11). Intimate sexual contact and blood products are believed to be the main modes of transmission (9,10).

THE ACQUISITION OF INFECTION

The consequences of HIV infection range from no detectable disturbance of health to death from opportunistic infections, tumours or encephalopathy. The onset of infection is sometimes charaterized by a brief gandular fever-like illness:- sore throat, fever, tender lymph nodes, arthralgia, myalgia, malaise, splenomengaly, a maculopapular rash and occasionally encephalopathy (12). Thereafter the majority of infected persons remain in normal health for a variable length of time.

DEVELOPMENT OF PATHOLOGY

In many persons, the HIV infection starts by lymph node enlargment but they remain asymptomatic. These nodes are firm, non tender, mobile, bilaterally and symmetrically placed. Histologically they show hyperplasia of germinal centres and tingible body macrophages with increased mitotic activity. If the lymph node histology show destruction of the dendritic reticulum cell network, the patient is more likely to develop AIDS (12). Later patients tend to develop symptoms as their immune function deteriorates. Some workers classify patients with persistent generalized lymphadenopathy (PGL) into two groups:- type A (asymptomatic) and type B (symptomatic (12).

THE AIDS RELATED COMPLEX (ARC)

This is a term used to describe a prodromal syndrome from which the majority of patients progress to AIDS within a few months (12). Such patients are symptomatic with weight loss up to 15% of their total body weight, chronic fever, night sweats, oral candida and chronic diarrhoea. Villous atrophy may be found on jejunal biopsy. Lymphopaenia, T-helper cell depletion, decreased platelets and thrombocytopenia (13) probably due to ingestion of immue complex coated platelets by cells of the reticulo-endothelial system are found. Skin lesions are common (14).

AIDS - CLINICAL PRESENTATION

Presentation is different in the Northern and Southern hemispheres. In homosexual men (USA) the majority who have AIDS suffer from serious opportunistic infections. Candidiasis is a common opportunistic infection of AIDS causing oesophagitis leading to dysphagia and retrosternal pain (10).

Cryptosporidium, a protozoan (15) and Isospore belli which lead to intractable diarrhoea bring patients to the surgeons' attention for sigmoidoscopies, colonoscopies and rectal biopsies. Histology of the specimen show atrophy of the mucosa. Other causes of diarrhoea include atypical mycobacteria (Mycobacterium avian - intracellulare) (45) which are resistant to conventional anti TB drugs, and cytomegalovirus which causes colitis, bloody diarrhoea, abdominal pain and distension (16) which may be confused with acute surgical emergencies.

However, in the Southern hemisphere AIDS commonly manifests itself as the aggressive form of Kaposi's Sarcoma (AAKS) (17,18), although presentations differ from country to country within Africa. In Zambia AIDS commonly presented as The Aggressive African Kaposi's Sarcoma (17) while in Uganda it presents as the Slim Disease (24), and in Zaire cryptococcus meningitis is the commonest presentation.(9) Most patients with Atypical Kaposi's Sarcoma have a shorter history than those with endemic KS. Lymphadenopathy is generalized and symmetrically placed. Peripheral nodules are commonly seen and plaque lesions occur in unusual sites ie. trunk or face, vulva, thighs and sometimes associated with severe swelling (17,18).
Gross weight loss is a common finding sometimes amounting to one-third of the total body weight. Purple plagues and nodules are usually seen on the hard palate or tonsils although these can occur anywhere in the mouth. Fibreoptic endoscopy may reveal nodules purplish in colour and resembling cutaneous lesions in the oesophagus, stomach and duodenum. Similar lesions are found in the rectum at sigmoidoscopy (personal communication by A C Bayley). Some patients present with respiratory distress probably due to pulmonary infiltration. Symptoms in AAKS are often relieved by Actinomycin D and Vincristine, but recur within a few weeks (18).

Mortality is very high in this group of patients with aggressive Kaposi's Sarcoma. This variety of Kaposi's Sarcoma is very similar to the tumour described in the acquired immune deficiency syndrome of homosexual men.

In 1986 a random survey of 327 subjects in the Central African Republic revealed that 19% of prostitutes and 4% of all others surveyed carried the virus - but only 202 cases of AIDS have been reported so far. In East Africa on the other hand, Uganda has reported the highest number of AIDS patients (22). According to Serwadda (24) most of the 1,138 cases reported presented with 'Slim Disease', chronic diarrhoea, excessive weight loss and oral thrush. Persistent generalised lymphadenopathy is less commonly seen (24). In one Kampala hospital 24% of pregnant women surveyed carried the virus in 1987 (24). Although Kenya borders on Uganda, so far only 286 cases have been reported to the WHO. But, according to WHO officials - lack of reporting or poor reporting procedures probably under-estimates the actual number of AIDS cases (22). Tanzania has reported the second highest number of cases. As in Uganda, most of the 1,130 afflicted patients suffer from Slim Disease' and 70% of the reported cases reside in the northwest corner of the country. The rural epidemic in Tanzania is similar to that found in Uganda (22).

In 1986 in Zambia 13% (11) of blood donors on the Copperbelt and 18.4% (22) of blood donors in Lusaka, were seropositive. In 1985 at the University Teaching Hospital, Lusaka the seroprevalence was reported to be 29% in the STD clinic, 26.8% in dermatology, 23% in surgical admissions and only 8.7% in antenatal attenders. So far 250 cases of AIDS in Zambia presenting as the aggressive form of KS have been reported to the WHO, 65% of whom are skilled professionals (22).

CRITERIA FOR DIAGNOSIS OF AIDS

(1). Any patient in whom the HIV serological test result is not known either because the test is not done or the result inconclusive-but has indicators for AIDS (i.e. Pneumocystis carinii pneumoniae; extrapulomonary cryptococcus, Kaposi's Sarcoma in a patient below (60 years) can be diagnosed as such provided other causes of immunodeficiency are excluded.

(2). Any patient with laboratory evidence of HIV infection irrespective of other causes of immunodeficiency.

(3). A patient with a negative HIV serological test where other causes of immunodeficiency has been excluded but the patient has Pneumocystis Carinii, or atypical Kaposi's Sarcoma. Diseases indicative of AIDS and a T helper/inducer cell count below 400/uL (25) can be diagnosed as AIDS patient.

THE OBJECTIVE

To study the nutritional status of patients with HIV infection in Zambia.

THE INTERACTION BETWEEN NUTRITION, INFECTION AND IMMUNITY

There is a correlation between nutrition, infection and immunity (26) as shown by an increase in the incidence of diarrhoea in wasted (w/t less 80% of standard) children (27). The incidence of diarrhoea is twice that of a non wasted child and the duration of diarrhoea is increased by 33% in underweight, 37% in the stunted and by 79% in the wasted. Measles is prolonged and severe in malnourished children (28). Patients who have lymphoreticular malignancies develop pneumonia due to Pneumocystis carinii when their serum albumin levels are low. In children with Kwashiokor T-cell rosette formation is distinctly lower than in marasmic children and this impaired function is corrected on refeeding (29). Furthermore, the peripheral blood lymphocytes show a decreased transformation to phytohemagglutination. The Mantoux text conversion following BCG is lower in children with Kwashiokor than in controls and so the delayed cutaneous hypersensitivity reaction is depressed to candida and diptheria toxoid antigens (3). Refeeding of the malnourished leads to recovery of these in vivo tests.

There is synergism of infection and malnutrition (31). Each of these can lead to impairment of the immune responses. For instance:- infection and fever cause significant losses of nitrogen by excretion through the kidneys as a result of increased matabolism as well as by depressing appetite. In gastrointestinal infections, accompanying diarrhoea contributes to further losses of protein and other nutrients. As a consequence of this, proteins essential for adequate synthesis of antibodies and other components of the immune system are lacking (32). In HIV infections fever, diarrhoea and weight loss as well as opportunistic infections, are common clinical findings (16). Infection per se leads to an increase in the acute phase proteins such as:- C reactive proteins, and macro globulins and antitrypsin and haptoglobin, which adversely affects the synthesis of antibodies (32) and at the same time the proportions of T4 helper cells, T8 cytotoxic and suppressor cells are reduced (33). The opsonic activity of plasma and chemotactic migration of neutrophils is reduced. Phagocytosis of bacteria is normal but intracellular bactetrial and candida killing capacity is impaired.

Deficiencies in folic acid, pyridoxine and Vitamin A impair cell-mediated immunity and T-cell-dependent antibody responses (34). Zinc deficiency impairs cell mediated immunity increasing vulnerability to Listeria, Salmonella and Coxsackie virus. Iron deficiency tends to impair lymphocyte stimulation response to mitogens and to decrease neutrophil bactericidal capacity (32).

Histology of the lymph nodes in malnourished patients shows atrophy of lymphatic tissues ie. tonsils, thymus, nodes and Peyers patches. The thymus also shows poor demarcation between cortex and medulla, reduction in normal lymphoid cells and Hassall corpuscles are crowded, dilated, degenerate or even calcified.

There are thus many possible causes of malnutrition in HIV-infected patients. Direct invasion of T4 lymphocytes directly depresses the cell mediated immunity. Dysphagia resulting from candidiases leads to depression of appetite while the diarrhoea due to cyrptosporidium and Isospore belli result in loss of proteins and trace elements. The structural damage of the gastrointestinal system by the atypical Kaposi's Sarcoma lesions and the HIV invasion of the Peyers patches probably lead to impaired digestion and malabsorption and therefore decrease in the micro and macro nutrients required in the synthesis of proteins required by the immune system. Low lysozyme levels change mucosal immunity permitting colonization and contact of pathogens with the epithelial cells leading to an increased risk of systemic spread (34) (Table 1).

TABLE 1 The Causes of Malnutrition in HIV Infections

1. Dysphagia and retrosternal pain due to:
   - Candidiasis
   - KS lesions

2. Malabsorption as a result of diarrhoea caused by:
   - Cryptosporidium
   - Isospora belli
   - Cytomegaloviruses
   - Gut invasion by HIV

3. Fever leading to increased catabolism

Although patients with severe malnutrition are easily recognisable, nutritional impairment may often go unnoticed by clinicians (39). As a result a number of tests of nutritional status have been devised but no one test has proved to give a true picture of the nutrition state on its own (Table 11).

TESTS USED FOR ASSESSING NUTRITIONAL STATUS

TABLE II Tests Used in Nutritional Assessment

A. Biochemical Tests	B. Anthropometric Measurements
1 Serum Total Protein	1. Height
2. Serum Albumin	2. Weight
3. Prealbumin	3. Triceps Skinfold Thickness
4. Serum Transferrin	4. Skin Tests
5. Retinol Binding Protein	
6. Urinary creatinine	
7. Total lymphocyte Count	
8. Serum folate	
9. Zinc serum level	

ANTHROPOMETRIC TESTS FOR EVALUATING NUTRITIONAL STATUS

Anthropemetric Evaluation of nutritional status using height, weight and various measures of limb size are sensitive indices to changing food intake and therefore can indicate nutritional well-being. These help in comparing an individual's response to his nutritional environment with that of the population, (32). Body weight is a reflection of relative amounts of body fat, bones, water, body cell mass and solids. The ideal weights are a reflection of the average weight as ascribed to individuals of the same heights. The actual weight is seen when an individual is measured on a standard scale.

However, comparison is usually done with the ideal weight and is expressed as a percentage of the ideal body weight calculated as:-

i) % ideal body weight = $\frac{\text{actual weight}}{\text{ideal weight}} \times 100$

ii) % usual weight = $\frac{\text{actual weight}}{\text{usual weight}} \times 100$

iii) % weight change = $\frac{\text{usual} - \text{actual weight}}{\text{usual weight}} \times 100$

Weight for age expresses the relationship of weight expected for a specific age and sex. In 1969 Jelliffe stressed the need for measurements independent of age, since age independent measurements are based on the ratio of nutritionally labile tissue ie. muscle mass or subartaneous fat to short term malnutrition eg. height, head circumference in children or length of bone. In some parts of the world including Zambia, birth records cannot be verified, hence age cannot be used realibly.

Triceps Skinfold Thickness and Midarm Circumference

This indirectly estimates body fatness (calorie stores). Triceps skinfold thickness help in calculating the mid upper arm muscle mass. The triceps site is universally accessible and in protein calorie malnutrition, it is usually not edematous (32). The other best site is the subscapular area just below the scapular. The mid upper arm circumference aids in calculating arm muscle circumference and the arm muscle area when used in junction with the triceps skinfold thickness using nomograms developed by Gurney (35).

The arm muscle circumference is a sensitive index of body protein reserves, althought it is a rough estimate since it does not take the thickness of the humerus into account (32).

BIOCHEMICAL TESTS USED IN NUTRITONAL ASSESSMENT

a) Biochemical

Serum Total Protein are of little value in assessing the nutritional status of an individual as they tend to be elevated in septic conditions due to increased globulins (36) and in dehydration or malnutrition (37).

b) Serum Albumin

This is measured in grams per litre. The normal value in an adult should be more than 35/g/l (36). This makes up 50-65% of the total serum proteins. Low levels occur in situations of poor proteins intake, impaired digestion or inadequate absorption of exudative enteropathy (37). Acute decrease can occur within days in catabolic stress where insulin release in response to stress depresses amino acid release from muscle to maintain synthesis of serum proteins (38). This is reversed by feeding. This test correlates well with arm muscle circumference and hence is reliable and sensitive (39).

c) Pre albumin

Retinol binding protein complexed with Vitamin A, is bound to circulating pre albumin for transport. It has a half life of 2 - 3 days. It is measured by radial immunodiffusion (40). It is a sensitive indicator of protein deficiency and responds to refeeding Normal levels are 20-50 mgs/100 mls.

d) Serum Transferrin

This protein which can bind 2 molecules of iron has as its main function the transport of iron. 30 - 40% is normally used for iron transport (41). Decreased values are found in protein malnutrition, protein enteropathies, chronic infection or liver disease. Elevated levels occur in chronic blood loss, iron deficiency or pregnancy (38,40). It is a more sensitive index of malnutrion than serum albumin (39). It rapidly decreases under catabolic stress as it has a half life of 8 - 10 days. It is measured by immunologic methods.

e) Retinol Binding Protein

It is considered sensitive in developing protein deficiency. Levels return to normal rapidly with feeding. When the liver is diseased synthesis of RBP and release complexed with Vitamin A is decreased. RBP and pre albumin its transporter are more sensitive indices of malnutrition. Levels also decrease in malnutrition due to decreased synthesis by the liver (42).

f) Urinary creatinine

Creatin, a precursor of creatinine is found mainly in muscle. Therefore, creatinine excretion is related to muscle mass. Excretion is constant (38,40) although minor day to day and diurnal variations occur. Normally 20-26 mg per kilogram body weight per 24 hours is excreted in men, in females it is 14-22 mg per kilogram body weight per 24 hours (43).

Body wasting diseases lead to a decrease in excretion. The creatinine height index may be used in assessing lean body mass as height is a constant index as opposed to weight which varies according to body fluid and fat stores (39).

g) Serum Folate

Although commonly measured, low values may reflect recent low intake as opposed to deficiency. Prolonged low intake leads to megatoblastic anaemia (36). Red cell folate levels are more accurate and less variable since they reflect folate status at the time of the red cell formation. Measurement of this index is by indirect methods involving measuring whole blood and serum folate and relating the results to the hematocrit (36).

h) Zinc

Deficiency of zinc is associated with poor wound healing, decreased appetite, abnormal taste and smell. Low Serum values commonly occur in hypoalbuminaemia (44). Increased urinary excretion occur especially in alcoholic cirrhosis. More accurate tests involve the hair content of zinc, a reflection of actual zinc status (36).

k) Skin Tests

Cutaneous Anergy is the inability to express cell mediated immunity as commonly seen in sarcoidosis and Hodgkins disease when the tuberculin antigen is used. In Hodgkins disease, there is an associated predisposition to opportunistic infections. Hodgkins disease and sarcoidosis affect the paracortical areas of lymph nodes and the white pulp of the spleen by granulomatous type reaction (45). It is in these areas that T lymphocytes normally migrate to and proliferate when antigenically stimulated. Delayed hypersensitivity and cell-mediated immunity are suppressed in influenza, varicella and type I polio viruses due to their cytopathic effects on lymphocytes (46). A similar reaction would be expected with HIV infection as the viruses have a profound cytopathic effect on T lymphocytes (7). The test for cutaneous anergy was not used in this study because of lack of reagents, notably:- Candida albicans, mump skin test antigen, purified protein derivative, streptokinase and trichophyton antigens,. Besides, the tests would not have helped in assessing the nutritional status of the AIDS patients since the anergy anticipated is due to a direct cytotoxicity effect on lymphocytes (4).

l) Total Lymphocyte Count

This is expressed as numbers per cubic millimetre (1500-4000 per mm3). Malnutrion depresses the immune system leading to a fall in lymphocyte count due to decreased release of amino acids from muscle for synthesis of lymphocytes (39). Cell mediated immunity is assessed by the use of skin tests.

m) HIV Antibody Test

Detection of antibodies against the HIV was done by the use of the competitive enzyme linked immunosorbent assay (Wellcozyme). Unlike other tests - this assay has been shown to give specific reactivity for sera from Africa (47). Previous exposure to the virus is detected by measuring antibodies in the serum or plasma using microwells coated with the antigen from the virus (47). For confirmatory testing of borderline cases the immunofluorescence (Western Blot) test is used as it does not cross react with antibodies against malaria parasites (48).

METHODOLOGY

PLACE OF STUDY

This study was undertaken at the 1,500 bed University Teaching Hospital and at the 350 bed Saint Francis Hospital respectively. The University Teaching Hospital (UTH) is the only hospital for the entire city of Lusaka and the main referral centre for the whole country. Saint Francis Hospital (SFH) is a major referral centre in the Eastern Province of Zambia.

MEASUREMENTS AND PATIENT SELECTION

In this study, due to the non availability of certain laboratory tests at the hospitals where the study was conducted, nutritional assessment was limited to the use of anthropometric tests of:-height, weight, mid arm circumference and the triceps skinfold thickness. The only biochemical tests used were total serum proteins and serum albumin. All these indices were easy to perform and did not require expensive and elaborate equipment. All except venipuncture were non invasive.

Standardised interviews were used by the investigator for all subjects seen during the study, and verbal consent was obtained in all cases. Data obtained regarding age, sex, previous medical history and measurements were entered on pro-formas. Age was obtained by personal interviews and recorded in years.

Height to the nearest centimetre was measured with the patient standing on a hard flat surface leaning against a wall or door with bare feet together and legs fully extended. The heels, calves, buttocks, trunk and shoulders all were made to touch the vertical wall while a movable rigid ruler rested on the crown of the head and with the patient's eyes pointing directly forward.

Weight was measured using a beam scale and recorded to the nearest 0.1kg. Excess clothing and shoes were removed when measurements were being done and 1kg was allowed for the remaining clothes. The same scale was used for both the University Teaching Hospital and Saint Francis patients and controls.

The mid upper arm circumference was measured to the nearest centimetre on the patient's non dominant arm - (usually the left), using a non crimping tape measure. The mid point is half way between the olecranon and acromion and the measurement was taken with the arm hanging loosely by the side.

The triceps skinfold thickness was taken from the previously marked point on the left arm. A vertical pinch of the skin and subcutaneous fat was gently pulled between the thumb and forefinger 1 cm above the mid point mark. The skinfold callipers were gently placed over the skinfold and the reading was taken to the nearest 0.2 millimetre. Three readings were taken and averaged. Specially designed calipers exerting pressure of 10gm/mm2 on a contact surface of 20-40 mm (49) was used.

I studied adult patients (over 18 years), including outpatients and referrals to the UTH Tumour Clinic with evidence of atypical Kaposi's Sarcoma or opportunistic infections such as candidiases or chronic persistent and generalized lymphadenopathy in extra inguinal sites were included irrespective of the provisional diagnosis. Inpatients in the surgical wards with the clinical diagnosis of AIDS or Kaposi's Sarcoma were also included. Patients with other malignancies as seen in the tumour clinic were not included in this study unless clinically they had evidence of HIV infection. All these patients were only seen on one occasion usually on their first outpatients appointment. No follow-up was done due to the limited time in which this study was undertaken.

My controls were adult patients (over 18 years of age) admitted to the UTH medical wards suffering from any condition other than chronic diarrhoea with weight loss, PGL or HIV infection. Complication free adult trauma patients seen in the UTH casualty department made up the bulk of the controls.

At (SFH), Katete the patients and controls were similarly selected.

For all controls and patients 20 millimetres of blood was collected by venipuncture and centrifuged within an hour of collection.

Sera for total protein and albumin were sent and analysed by an automatic analyser the same day. However, sera for HIV serological tests were stored at 20°C until ready for analysis within 4 months of collection by the use of a competitive enzymelinked immuno-sorbent assay test (Wellcozyme).

The anthropometric standards used in this study were based on those used in the Liberia National Nutrition Survey (1976) and elsewhere in the Third World (50). The minimum acceptable height in centimetres was 150 cm, mid arm circumference was taken as 23 cm and the triceps skinfold thickness was taken as 7.5 mm. The biochemical tests used were based on those recommended by Sauberlich (36) which were chosen because the Zambian population groups have no standards of their own.

RESULTS AND DATA ANALYSIS

A total of 211 Zambians were interviewed and measurements of height, weight, mid arm circumference and triceps skinfold thickness were noted. 62 of the subjects were excluded from further analysis due to lack of medical data anthropometric measurements or biochemical test results. Of those excluded 9 had clinical AIDS, 8 had PGL, 10 medical patients who were too ill to stand and 12 casualty controls at the UTH. At SFH, Katete, excluded were clinically 7 AIDS patients, 6 medical controls and 10 casualty control. The excluded patients did not have biochemical and HIV serological tests done because sera bottles broke in the laboratory before testing. There remained a total of 149 Zambians who were interviewed and had complete measurements available for analysis (Table 111).

At the UTH, 27 patients were compared with 46 controls. The 27 patients consisted of 11 AIDS patients and 16 PGL patients. The controls consisted of 16 medical controls and 30 complication free trauma patients. From the SFH, Katete group of subjects:- 15 were AIDS patients, 30 medical controls and 31 complication free trauma patients. At SFH, Katete, therefore, 15 patients were compared with 61 controls. Table 1V shows the breakdown of subjects studied according to diagnoses.

The variables that were analysed by the student's T test for the UTH and Katete subjects are shown in Table 111. These are the mean ages in years, mean weights in kilograms, the mean heights in centimetres, the mean midarm circumferences in centimetres, the mean total serum protein in grams per litre and the mean serum albumin in grams per litre. The results of the students' T tests done on both the University Teaching Hospital patients and controls are shown in Table V which shows that all analyses were not significant at the 5% level.

Table VI shows by numbers subjects in each group defined as being malnourished according to the Liberian National Nutritional Survey i.e. MAC below 23cm, TSF less than 7.5mm, total serum protein less than 65g/L and serum albumin below 35g/L.

However because of the small numbers in each group defined as malnourished a Fisher's exact Test was used to analyze by the totals of subjects in each group (Table V11) and no signinicant differences statistically were noted at the 5% level.

Since controls were obtained from both the urban and rural medical wards - a pilot study consisting of sera from 10 patients from each location were analyzed for total serum protein and albumin (Table V111). The students T test was then used to test for statistical significance - but no statistically significant differences were noted p=0.2098 for total serum protein and p=0.6832 for serum albumin.

TABLE 111: RESULTS OF THE STUDENT'S T-TESTS DONE ON BOTH THE UNIVERSITY TEACHING HOSPITAL (UTH) AND ST. FRANCIS HOSPITAL PATIENTS AND CONTROLS

	UTH AIDS	PGL	MEDICAL	CASUALTY	KATETE AIDS	KATETE MEDICAL	KATETE CASUALTY
UTH AIDS	///	NS	NS	NS	NS	Albumin P<0.001	NS
UTH PGL	NS	///	NS	NS	NS	NS	NS
UTH MEDICAL	NS	NS	///	NS	NS	Serum Protein P<0.001	NS
UTH CASUALTY	NS	NS	NS	///	NS	NS	NS
KATETE AIDS	NS	NS	NS	NS	///	NS	NS
KATETE MEDICAL	NS	NS	NS	NS	NS	///	NS
KATETE CASUALTY	NS	NS	NS	NS	NS	NS	///

NS = Not significant
T-test not significant at 5% Level
For all nutritional parameters (Height, weight, MAC, SFT)

PGL: Persistent Generalised Lymphadenopathy

TABLE IV: Table of Diagnosis

	AIDS	PGL	MEDICAL CONTROLS	CASUALTY CONTROLS
UTH	11	16	16	30
SFH	15	–	30	31

TABLE VI: RESULTS OF NUTRITIONAL MEASUREMENTS ON PATIENTS AND CONTROLS AT THE UNIVERSITY TEACHING HOSPITAL (U T H) AND ST. FRANCIS HOSPITAL USING CUT-OFF POINTS USED IN THE LIBERIAN NUTRITIONAL SURVEY.

	UTH AIDS	MEDICAL	PGL	CASUALTY	KATETE AIDS	MEDICAL	CASUALTY
COUNT	11	16	16 ,	30	15	30	31
MAC							
Below 23cm	3(27.3%)	7(43.75%)	2(12.5%)	4(13.3%)	5(33.3%)	10(33.3%)	2(6.94%)
Above 23cm	8(72.7%)	9(56.25%)	14.87(5%)	26(86.7%)	10(66.7%)	21(70.0%)	29(93.06%)
TSFT							
Below 7.5mm	5(45.5%)	11(68.8%)	6(37.5%)	9(30%)	9(60%)	23(76.6%)	17(54.8%)
Above 7.5mm	6(54.5%)	5(31.2%)	10(62.5%)	21(70%0	6(40%)	7(23.4%)	14(45.2%)
Total Protein							
Above 65 g/l	9(81.8%)	9(56.3%)	15(93.8%)	27(90%)	11(73.3%)	26(86.7%)	20(64.5%)
Below 65 g/l	2(18.2%)	7(43.7%)	1 (6.2%)	3(10%)	4(26.7%)	4(13.3%)	11(35.5%)
Serum Albumin							
Above 35g/L	5(45.5%)	4(25%)	13(81.3%)	25(83.3%)	5(33.3%)	6(26%)	18(58%)
Below 35g/L	6(54.5%	12(75%)	3(18.3%)	5(16.7%)	10(66.7%)	24(79%)	13(42%)

Cut off points based on those used in the Liberian National Nutrition Survey

Serum Albumin 35 grams per litre

MAC: Mid arm circumference (MAC) 23 centimetres

TSFT: Triceps skinfold thickness in mm.

PGL: Persistent Generalised Lymphadenopathy

TABLE V : NUTRITIONAL MEASUREMENTS, MEANS AND RANGES PLUS STANDARD DEVIATIONS FOR BOTH PATIENTS AND CONTROLS AT THE UNIVERSITY TEACHING HOSPITAL(U T H) AND ST. FRANCIS HOSPITAL.

	U T H Patients AIDS	U T H PGL	U T H Medical	U T H Casualty	KATETE AIDS	KATETE Medical	KATETE Casualty
Count	11	16	16	30	15	30	31
Age	39.64±12.3 (24-70)	27.8±5.6 (24-70)	39.0±13.6 (24-70)	27.7±9.0 (18-60)	29.±10.7 (24-56)	27.7±13.4 (19-70)	31.6±13.4 (18-65)
Weight	57.5±6.8 (43.1-68)	59.3±7.9 (38-81)	57.2±10.8 (42-81)	59.8±7.9 (45-66)	39.6±10.0 (45-66)	37.7±8.3 (40.3-66.5)	52.8±8.3 (44-74)
Height	168.6±8.3 (150-179)	164.3±9.0 (148-189)	169.8±6.8 (161-185)	167.8±6.7 (159-180)	166.9±9.1 (150-184)	160.2±7.5 (150-171)	151.1±7.5 (151-177)
MAC	24.9±2.8 (21-29)	25.4±2.6 (17-28)	24.8±3.8 (19-32)	25.9±3.5 (21-30)	22.7±3.5 (16.5-27)	24.1±3.2 (19-28)	28.0±3.2 (21-38)
SFT	6.4±1.6 (4.2-8.3)	9.8±5.4 (4.7-18.2)	7.4±4.2 (3.8-15.1)	10.3±5.4 (4.2-26.1)	6.5±2.7 (2.4-11.5)	5.8±5.3 (3.6-8.6)	9.5±5.3 (3.2-18.2)
Protein	82.8±6.8 (76-94)	83.7±7.0 (73-97)	81.4±6.7 (75-92)	78.9±7.0 (71-90)	73.5±9.5 (62-89)	70.2±6.5 (59-89)	72.8±6.5 (66-90)
Albumin	36.7±7.1 (33-48)	40.4±4.5 (31-48)	31.0±8.1 (24-39)	37.7±3.0 (35-40)	27.8±6.7 (17-39)	27.7±6.7 (17-36)	31.0±6.7 (18-39)

KEY
Age - in years
Weight in Kilograms
MAC: Mid Arm Circumference in Centimetres
Height in Centimetres
SFT:Skin Fold Thicknessin Millimetres
Protein in grams per litre
Albumin in grams per litre
PGL: Persistent Generalised Lymphadenopathy

TABLE VII: Comparisons of Serum Proteins made between patients and controls

AIDS vs	UTH 16	MEDICAL	NS
UTH "	30	CASUALTY	NS
11 "	16	PGL	NS
AIDS vs	15	SFH AIDS	NS
UTH	30	MEDICAL	NS
11	31	CASUALTY	NS
UTH MEDICAL vs 16	30	SFH MEDICAL	NS
UTH CASUALTY vs 30	31	SFH CASUALTY	NS

Fishers Exact Test. NS = not significant at 5% level.

Table VIII. The means and P-values of total serum protein and albumin levels from UTH and Katete Medical Wards

	UTH Protein Total	KATETE Protein Total	UTH Serum Albumin	Katete Serum Albumin
1.	86	88	39	38
2.	79	91	30	29
3.	78	24	40	19
4.	92	99	40	46
5.	83	82	20	34
6.	75	40	32	15
7.	91	77	23	27
8.	77	77	39	34
9.	76	74	24	31
10.	74	67	40	38
Means	81.4	32.7	71.2	31.1

Serum protein measured in grams per litre by students t test

Total Serum protein - p=0.2098

Serum albumin measured in grams per litre by the students t test

Serum albumin - p=0.6832

Statistically not significant.

HIV serological positivity at the UTH was 100% for clinically AIDS patients, 57.6% for PGL patients (7 positive, 33.0% for medical controls (4 positive) and 33.3% for casualty controls (3 positive and 8 borderline). At SFH, Katete the HIV serological positivity were 100% for clinically AIDS patients, 26.6% for medical patients (8 positive) and 9.6% for casualty controls (3 positive) Table 1X

TABLE IX: HIV Seropositivity Results

	SEROPOSITIVE AIDS	PGL TOTAL	MEDICAL CONTROLS	CASUALTY CONTROLS
UTH	16 (100%)	7 (57.6%)	4 (33%)	8 (33%)
SFH	15 (100%)		8 (26.6%)	3 (9.6%)

DISCUSSION

Interviews and measurements were done on an assortment of volunteers ranging from peasants, office orderlies, civil servants to professional men and women.

As the study was limited to adults, the height for age index was not used in the assessment of nutritional status. This index is usually used in establishing stunted growth in children due to the end result of cumulative episodes of nutritional insults such as infection and inadequate food leading to failure of bone growth (40). In adults, because of the multitribal attributes - differences in height occur, making it difficult to attribute these differences to undernourishment. Weight was measured once only, so it was a less sensitive index for assessing nutritional status in AIDS patients. A longitudinal study, would have shown whether weight changes were occurring with the progression of disease. The lack of standard weight for height charts for Zambian populations made it difficult to assess the nutritionally labile tissues such as muscle and fat in comparison with the more stable skeletal measure of stature. The heights for Zambian correlated well with those of the Vendas (51) and Pedis (52), but their weights did not correlate well with those of Zulu (21) women who have a higher mean weight, probably due to genetic and cultural factors.

Statistical analyses of the findings of this study showed no significant differences between the patients and controls, including the findings in the pilot study where sera from 10 medical patients from the UTH and 10 medical patients SFH, Katete respectively were compared for total serum protein and albumin levels. This is an expected finding since studies done elsewhere have shown that medical patients (39) are usually malnourished. Therefore, although medical controls were drawn from two locations, the means of their total serum protein ($p=0.2098$) and serum albumin ($p=0.6832$) were not statistically significant especially since analysis of these sera were done at the UTH using the same autoanalyzer.

However by using cut off points based on the ones used in the Liberian National Survey - trends emerge revealing medical inpatient and to a lesser extent AIDS patients as the least well nourished. The discussion that follows accepts that a large case study is necessary before these trends can be considered as proven.

MEDICAL IN PATIENT CONTROL

The midarm circumference measurements showed that 43.75% and 33.3% UTH and SFH in patients were below the 23cm cut off point. The skinfold thickness which measures fat stores was below the 7.5mm cut off point in 68.8% of UTH and 76.6% of SFH medical patients. This suggests that both urban and rural medical patients have little fat stores and therefore less energy reserves. Although the numbers are small 33% of UTH medical in patients were HIV positive and it was these patients who were the most likely to show evidence of reduced lean body mass. This is in contrast to the SFH medical patients who revealed a seropositivity of 26.6%, the difference between other comparisons was not statistically significant. Hospitalized patients have been shown to have some degree of undernutrition in other studies (39). As expected rural medical patients had serum protein levels above the standard in 86.7% as opposed to 56.5% in the urban counterparts. This high serum protein level in the rural medical patients could be attributed to high immunoglobulins associated with high septic conditions. Serum albumin levels were below 35g/L in 79% of rural medical patients because of a possible combination of diets poor in protein as has been found in the South African Pedis (51) and vendas (50) and the associated effect of the HIV infection in the 26.6% of patients who were found to be positive. The high prevalence of HIV infections in urban medical patients (33%) may have further increased the state of undernutrition in this group resulting in 75% being below 35g/L serum albumin.

Serum albumin is a more sensitive index of measuring the nutritional status of an individual because usually a fall in serum albumin inversely leads to a rise in immunoglobulins, hence the finding that 75% of UTH and 79% of SFH medical patients respectively were below 35g/L strongly suggest that these patients were indeed malnourished as they were chronically unwell and had reduced lean body mass culmunating in impaired immune function.

AIDS PATIENTS

27.3% and 33.0% UTH and SFH respectively showed values below 23cm of the cut off point. The fewer cases at UTH with low MAC values tends to support the finding of low lean body mass in the rural patients at SFH despite the fact that all had the same disease. The skinfold thickness clearly showed much lower caloric reserves in the rural AIDS patients - 60% SFH than 45.5% UTH AIDS patients. Total serum protein was above the normal 65g/L cut off point in 81.8% of the UTH AIDS patients and 73.3% of the rural SFH AIDS patients. Serum albumin was below 35g/L in 54.5% of UTH patients and 66.7% of SFH AIDS patients, which suggests malnutrition. This malnutrition could be due to HIV infection or to diets poor in protein especially in rural patients.

The hypoalbuminaemia, may be due both to impaired digestion and inadequate absorption and to chronic loss of protein as a result of chronic diarrhoea found in AIDS. Malnourished patients are probably more prone to acquire HIV infection while AIDS Syndrome may further increase under malnutrition in one already malnourished.

CASUALTY CONTROL

According to Sauberlich (36) a serum total protein of 65g/L and above is indicative of adquate nutrition. However, Keys (52) stated that malnutrition had to be gross before changes in total serum protein become manifest. This was found to be true in this study where only 35.5% of the rural trauma controls showed a serum protein level below 65g/L, despite the general belief that rural diets are poor in proteins. Serum albumin tests showed that as many as 42% of rural trauma controls had levels below the standard while only 18.3% of urban controls had levels below the standard as is the case elsewhere (49,50) and is usually attributed to superior diets found in urban communities.

The skinfold thickness revealed a low calorie reserve in the rural trauma controls 54.8% as opposed to the urban controls where only 30% were below the standard. 13.3% of urban trauma controls were below the 23cm MAC standard as opposed to only 69.4% of the rural controls, however, this was not statistically significant.

P G L

The results of the PGL (UTH) matched closely with those of the trauma controls (UTH). One possible explanation is that although these patients had HIV infection the disease process had not significantly impaired their general health.

CONCLUSION

This study showed that medical patients both urban and rural have the lowest caloric reserves and are the most malnourished The AIDS patients show some signs of being undernourished both in the urban and rural settings when compared with trauma controls. Urban trauma patients had a superior nutritional status when compared with their rural counterparts whose diets are probably low in protein. There was no difference in the prevalence of the AIDS virus in the normal urban and rural population ($p = 0.06$). However, due to the small numbers in this study figures should be interpreted with caution and more longitudinal studies are needed to confirm these findings.

The study was initially designed for large numbers but with the small number of cases as seen in my study a case control study would have been more appropriate.

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