THE DEVELOPMENT OF TEACHING TOOLS ON THE PREVENTION OF MALNUTRITION FOR THE PEOPLE OF BURUNDI, AFRICA

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INTRODUCTION

Problem

One of the most prominent problems which faces mankind today and the coming generation is the challenge of feeding the increasing population of the world. Food production is unable to keep pace with the population growth, and as a result mankind today is not being adequately fed. It is predicted that by the end of the century the population will double. In the food deficient regions of Africa, Asia, and Central America, the increase in food production is barely keeping stride with the population increase, thus preventing the improvement in diet quality which could have been expected as a result of increased food production (1).

Undernutrition not only impairs a man's health but impedes his ability to work. Albert Sarraut pointed out that in many of the

underdeveloped countries, men are undernourished because they do not work, and they cannot work because they are undernourished. In 1943 when the Pan American Highway was constructed in Costa Rica, a study was made of work productivity in relationship to food and health. It showed that the work productivity increased fourfold in 70 percent of the workmen after they were fed a proper diet. (2)

The most pressing problem today is not providing food for the adult or the workman to increase his productivity, but is the malnutrition of expectant and nursing mothers, of preschool age children, and of adolescents. These groups are the strategical factor impairing a nation's health, its capacity to feed its people, and its economical development. They are the adults of tomorrow, and many of the mothers are the food producers of today. (3)

Children are most vulnerable to malnutrition during the rapid growing periods. The morbidity and mortality rate is high in children up to five years of age, and those who survive the acute phases of malnutrition are left with physical and psychological scars. Dr. Marcel Autret, the Director of Food and Agriculture Organization of the United Nations, reported that the infant death rate in Western countries ranged from 10 to 30 per 1,000 live births during the first year of life, but in underdeveloped countries it ranged from 100 to 300 for every 1,000 live births. Still more appalling is the comparison of death rates among children from one to four years of age,

where malnutrition is a primordial factor. In France or Sweden, for each child in this age group who dies, there are 24 in India and 50 in Africa. (4)

Dr. D. B. Jelliffe, World Health Organization Consultant in Infant Nutrition, believed that the major factors contributing to malnutrition in the tropic and subtropic regions were poverty, unavailability of suitable food, lack of knowledge, and superstition. (5)

In 1950, the World Health Organization authorized Drs. Brock and Autret to do a study among the countries south of the Sahara. They found kwashiorkor widespread throughout Africa except in a few minor tribes whose diet consisted of animal produce. (6)

Dr. Jelliffe believed that for every child with severe protein-calorie malnutrition there were hundreds who have it in lesser degree which goes undiagnosed. (7) In many areas in Africa, during the second year of life, the majority of the children have retarded growth, soft brown hair, pale skin, and low serum albumin which are indications of malnutrition. Their resistance to inter-current diseases of childhood has become impaired. A true appraisal of the situation would include these children even with mild symptoms of kwashiorkor. (8)

The country of Burundi is the most densely populated area of Africa with 260 persons per square mile. It is one of the poorest newly independent states of Africa with an average annual income of

$35.00. There are very few natural resources to develop and there is a population too large to expand the agricultural projects. The literacy rate for the entire population is 15 percent. In 1968, only one child out of fifteen had an opportunity for primary education. (9)

During the survey Dr. Brock visited Bujumbura, the capital of Burundi; the information he received there was from Dr. Vincent, a Belgian medical officer. He said there was kwashiorkor in Burundi but it was not seen among the Bahutu, who cultivated beans for their staple food, or among the Batutsi, who gave their children curded milk to drink. (10) This statement was not in accord with what other health workers observed during that era. The cases treated in the hospitals then were not as numerous as today (1971), but there were cases among the Bahutu and even a few among the Batutsi children.

A survey, done in Burundi, of 100 preschool children with normal weight gains showed that the death rate among their siblings was 217 to 1,000 live births. Among these deaths, 36 to 1,000 live births were caused directly by kwashiorkor. Kwashiorkor and lesser degrees of malnutrition are an acute problem in the country of Burundi. (11)

Many are working together to combat the problem of malnutrition. 1. Some are conducting research in the etiology and the treatment of kwashiorkor and marasmus. 2. Some are experimenting in the production of high protein food additives which are inexpensive and

palatable. 3. The Food and Agriculture Organization has experimental programs for increasing food production and quality of food. 4. The World Health Organization and other interested organizations are also working in the area of health education and immunization programs.

In Burundi there is a need for a health education program which is ethnically adapted to the cultural and socioeconomical factors influencing the health and nutritional state of the Barundi people. At the present, only sporadic instruction is being given. The health worker will give instruction if he has time to prepare the material and present it. There are a few prepared lessons on feeding a six-month-old child, both in the Kirundi language and in the official language of French, which are published by the Ministry of Public Health. This publication has been helpful but does not adequately teach basic principles necessary to elevate the standard of food preparation and hygiene in the African home.

Another problem is teaching foreign concepts of germ theory and parasitic cycles in a manner which is logical to an illiterate people who are still bound with superstitions. The African health worker has learned these concepts in French while at school, and though he understands them finds it very difficult to transfer these to his everyday life, even in his own home and personal hygiene. He is unable to convey a proper interpretation of these concepts to teach others.

Often he will use the French word instead of explaining it in a more lengthy manner in Kirundi. Very few of the health workers have had any preparation for teaching. In preparing any curriculum material, these factors would have to be considered in order to prepare materials which could be used efficiently by African health workers.

Purpose

This study was of the development of some teaching tools to be utilized in clinics and classes to teach Barundi parents with pre-school age children adequate diet and the prevention of nutritional related diseases.

Clinical Setting Where the Teaching Plan Will be Implemented

In Burundi, as in many other underdeveloped areas of the world, there are still two systems of health care: that of the local medicine man, witchdoctors, and sorcerers; and that which has been introduced by the Western countries. During the colonial era, the African methods of health care were suppressed, but now they are again being used openly. The more common syndromes treated are snake bites, diarrheas, infertility, painful joints, tropical ulcers, and kwashiorkor.

There are two principle reasons why people still use the

witchdoctors' services. First, there may not be a Western type clinic or hospital near where they live. It may be as far as an eight-hour walk from their home. This is a long walk for anyone, but complicated by carrying a sick child or by a body weakened from illness, it is nearly impossible. During the night the medicine man will receive business from his local clientele because it is impossible to travel any length by foot at night. The second reason for use of their services is that some illnesses are thought of as "Kirundi" illnesses and therefore thought untreatable by Western medicine (especially joint pains, headaches [other than that caused by malaria], and migratory pains). Kwashiorkor was in this class and was considered untreatable by Western medicine, but during the past decade attitudes of many Barundi have changed as they have seen their child's health restored to normal when treated at kwashiorkor centers.

The Western medical services are either socialized governmental, semiprivate, or private. The semiprivate and private services are most commonly operated by Protestant or Roman Catholic organizations. The semiprivate denotes that the government subsidizes $800.00 for medicines annually and partial salary for a limited number of personnel. In return, free medical care is to be provided for all school children, governmental employees, and others holding national medical cards.

The facilities could be classified according to function as medical

centers with hospitals, or as rural clinics, where there are a few beds and limited obstetrical facilities. In the rural clinics there is either a nurse or a medical assistant in charge with aides doing most of the actual diagnosing and treating. There are also a leprosarium, a tuberculosis care center, and several maternity centers. There are a total of 18 hospitals of which eight are private and 71 rural clinics, 17 of these are private. There is a total of 2,116 beds, which makes one bed available for each 1,000 population. (12)

Serving these hospitals there are only 53 physicians, which is a doctor-patient ratio of 1 to 61,770. Many of the physicians are located at the principal medical center in the capital city of Bujumbura, which intensifies the need in the more densely populated areas in the central part of the country. At this medical center, there are clinical specialists who receive patients by referral from other centers throughout the country. The rural medical centers usually have only one doctor in residence, and his area will cover at least a sixty-mile radius. He is not only responsible for his patients, but he may also be the X-ray technician and assist in the laboratory and pharmacy and have responsibilities for administration and management. It is not surprising that the physicians in governmental services prefer to stay in Bujumbura instead of accepting a rural assignment.

The auxiliary medical personnel consist of medical assistants, nurses, nurse aides, midwives, and midwife assistants. The medical

assistants have had ten years of combined primary-secondary education plus five years of medical school. The nurses are either European or American, or they are Africans (predominately male) who have had three years of school beyond the 10 years of combined primary-secondary level. The aides have had one year of technical school past eight years of primary-secondary level. The midwife's education is comparable to that of an African nurse and her assistant's to that of a nurse's aide. The medical assistant and/or nurse is permitted to diagnose and treat illness, to do the simple surgical procedures of suturing lacerations, to remove foreign bodies, to do small skin grafts, and to perform other simple emergency procedures. The nurse aides are legally permitted to represcribe treatment, after an initial examination by the nurse, and to give medications and treatments. After having years of experience they can function beyond this level.

When a patient comes to clinic, he is first seen by an African health worker who questions him concerning his illness; then the worker either prescribes medication or laboratory examination and sends him home or he refers him to the European nurse or doctor. This appears on the surface to be a simple process, but because of the numbers who attend clinics it usually requires a half day of waiting in line before the patient completes his therapy. To the African who has no pressing schedule, a day at the clinic may be a pleasant

day of sitting in the sun and visiting with acquaintances. The women with small children bring a small bunch of leaves for their disposable diaper system and some boiled sweet potatoes or parched corn wrapped in a piece of banana bark for the child's midmorning snack. Many bring a gourd of banana beer for liquid refreshment on the long, tiring trip. Everyone drinks directly from the same gourd, including the small children.

Certain days are set aside for special clinics. Most medical centers have prenatal, well-baby, and leprosy clinics; some others conduct tuberculosis clinics, and most recently a few have started kwashiorkor clinics for the malnourished children.

The three clinics which could be meaningful in the area of preventing malnutrition are the well-baby, prenatal, and the kwashiorkor clinics. Many times the consultation at the well-baby clinic is a ritual of weighing the child and giving treatment for minor colds and coughs. No one is concerned about an insufficient weight gain or tries to find its etiology and to provide treatment for the child. Consequently, numerous children develop kwashiorkor even though attending clinic regularly. Parental instruction to this group is given infrequently. Classes are in an open air meeting to a very large group (100+) who seem more interested in observing their children than in the content of the lesson material.

Regular immunization programs of smallpox and anti-tuberculosis

have been conducted in well-baby clinics for many years, thus controlling smallpox in regularly vaccinized areas. During the past five years, the United Nations has furnished DPT vaccine, and this has brought about an amelioration in the morbidity and mortality rates of pertussis.

A number of kwashiorkor clinics were started after a nutritional seminar was conducted by the United Nations in Burundi in 1968. These clinics are designed to give the child a high protein meal, to treat his intestinal parasites, to immunize him against pertussis, and to instruct his parents how to feed him foods which are in the family garden or readily available.

Health instruction is usually given by the African health workers because they are better able to communicate with their own people and are interested in the program. However health workers are pressed for time, and thus teaching is omitted from the program.

Besides these regular clinics, some medical work has been done in the more remote areas of the country by mobile clinic facilities which make regular weekly, or monthly, visits to these areas for general clinic. There are numerous preschool children who attend these clinics for treatment of malnutrition, parasites, and childhood diseases. The people in these areas are very eager for assistance and for instruction.

Practical Teaching Methods

Factors which must be considered in selecting teaching methods are: (1) the high illiteracy rate; (2) the poor picture perception; (3) the low level of comprehension of lesson material; (4) their culture; (5) the material which may be used in open-air meetings; (6) the high distraction factor. Visual aids with written explanations are only a distraction because many are able to read only a few syllables and cannot join them together in a word meaning. Because of the low literacy rate they would focus their attention on deciphering what is written and miss the content.

Their picture perception is poor because their homes are often void of pictures. Some homes will peg pictures from the Sears and Roebuck catalog on their walls if they are fortunate enough to have acquired parts of a catalog. Most homes are without pictures, and when children enter school they have to be taught how to read pictures. In teaching young children and illiterate adults, simple pictures without excessive detail must be used, and then the teacher must read the picture for them. He may choose to ask the group what each article is individually and then ask them what is the theme of the picture.

Poor comprehension of lesson material does not denote a nationality of lower intelligence but one of different intelligence and a different way of perceiving illness than that of the Western thinking.

This comprehension level along with the cultural and socioeconomical factors take a key role in preparing lesson materials. The materials must make sense to them and fit into their logic in order for it to be meaningful to them and for learning to take place. If these concepts are not followed the African learner will disregard them as foreign propaganda.

Dr. William Burton, a noted educator, stressed the need of acculturating the lesson material to the people for whom it was prepared--even for use in the United States.

> The school generally attempts to impose middle class values upon huge numbers of lower class children. Problems, assignments, projects set by the school are, therefore, not at all the same problems when tackled simultaneously by upper and lower class children. The motivations are not at all alike. Many lower class children simply do not value the objectives and processes of the school, hence do not try. The school immediately dubs these children "unintelligent," "uncooperative," or "stubborn." The old class cliches may enter; the children are lazy, shiftless, irresponsible. The facts are that the school often simply does not meet their needs or ambitions, does not operate within their framework of values and motivations. (13, p. 248)

There is even greater danger in classifying people of an entirely different cultural background as unintelligent and uncooperative, or to think of them as shiftless and irresponsible. In actuality, the Western culture was superimposed upon African culture without consideration of the existing culture.

In choosing materials to be used in open-air meetings, two factors to be considered are the visibility and solidarity of the

materials. It is often too windy to display a poster made from thin paper or even to place objects on a flannel board.

In considering how to ameliorate the distraction factor, the lessons are concise, with not over two or three main points, and highly motivating. The maximum length of the total lesson does not exceed 15 minutes.

In considering these problems, the lessons are brief and highly motivating. The content was acculturated to the local conditions and followed African logic. The types of visual aids which are most practical and were used are: (1) teaching aid posters which depict familiar scenes and objects; (2) hand puppets which are neither foreign nor animal figures; (3) playlets; and (4) real life experiences. The posters are teaching aids, and they depict simple scenes without excess of detail. The visual aids depict the average Murundi in his normal setting. The material of which the posters are made are painted felt figures pasted on muslin. (The posters receive hard use and may be dampened by the rains.) Stick figures and cartoons were not appropriate as they are a source of amusement and distraction to a people not accustomed to their use. It is doubtful that puppets would be meaningful at the present level of picture comprehension. A hand puppet who spoke on African wisdom would very likely be acceptable and stimulate interest.

Using health workers to do role playing, or playlets, was

selected as a method of instruction. The Murundi is an uninhibited actor and does not have difficulty in playing a role but often likes to make the audience laugh. This disadvantage was alleviated by the instruction of health workers in the principles of role playing and in the lesson content objective.

Real life experience is another useful aid and has already been utilized in some clinical settings. One of the methods used was the parents of the children with kwashiorkor to plant a garden containing vegetables which are good food for their children. The intent of this method was to the parents to learn how to plant and care for crops which they do not usually plant. Another method of real life experience was to use actual articles as visual aids. These are very practical and meaningful to the class and should enhance learning.

Evaluation of Tools

It was not possible to use or supervise the use of the teaching tools personally in the population for which they are designed, but samples of each type of tool were sent to Burundi and were used in a typical clinical setting. They were used in groups of 20 to 30 parents in an open-air meeting using an African health worker to give the lesson.

Each lesson was evaluated by three people: an African health worker, a parent who had had some formal education, and an American

registered nurse. An evaluation sheet was used to measure the effectiveness of the tool. The tool was evaluated on three points: the lesson content, the interest shown by the parents, and the implementation of the tool. See Appendix A. Data from the evaluations were used as guidelines in revision of the tool.

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CHAPTER II

NUTRITIONAL DISEASE OF KWASHIORKOR

The term kwashiorkor (kwashi=the name of a boy born on Sunday; orkor=red, or "red boy") is a term in the African dialect of the Ga tribe in Accra, Gold Coast, meaning "the deposed baby"--the baby who has lost his position to the mother's breast and his privilege to be carried on her back. (14)

The syndrome develops after four to twelve months of improper feeding. During this period, there are frequent attacks of diarrhea, and the child is usually very irritable. Edema of the hands and feet occur next; then within ten days skin changes commence. First, these changes are seen on the ankles, knees, forearms, and elbow, then in the groin and on the lumbar region. There is depigmentation of skin and hair. The hair may become blonde with loss of curl and decrease of tensile strength. When kwashiorkor is associated with profound helminthiasis, the degree of depigmentation is greater. There are lesions at the corners of the mouth, around eyes, and in the mouth. The child is photophobic, and sometimes corneal ulcers develop. The child is very irritable but has no alteration in any of the

neurological reflexes.

If kwashiorkor is untreated, nearly all cases end in death. The mortality rate was as high as 40 to 60 percent among the treated cases before the etiology and contributory factors were known. Even in 1971, with the present knowledge, the mortality rate is 20 percent. (15, 16)

Historical Development

Dr. Cecily Williams (1933) was one of the earliest physicians who accurately described this syndrome of kwashiorkor while working in Accra, Gold Coast. She noted that this syndrome often developed when breast feeding was discontinued or in children who were nursed by an old woman or a pregnant woman. The child was concurrently on a gruel diet of either maize or other starchy roots. The disease occurred most commonly between the ages of six months and four years.

She had performed autopsies on several of these children and found them all to have fatty livers. She distinguished this condition from pellagra by an atypical dematosis and by the absences of neurological symptoms. Her impression of the etiology was that there was an essential factor lacking at birth, even though the child appeared healthy. This defect only became obvious after the child had extreme demands upon his reserve stores. (17)

The following year in 1934, Dr. H. Stannus, a medical officer in French territories of Central and West Africa, refuted Dr. Williams and stated that she had misdiagnosed her cases and that this condition is "Infantile Pellagra." (18) Dr. Williams wrote a journal article for the Lancet in 1935 titling it "Kwashiorkor" (19); this again brought down the wrath of Dr. Stannus upon her. He replied to her in a letter to the editor, asking why he had printed an article with an African native word for the title. "Who could know that this is a disease syndrome!" He furthermore commented that kwashiorkor was only a common superstition which occurred in many parts of Africa. Among the Wayae tribe of Central Africa, the disease was called "litange lya kututa"--each successive child is said to push the previous one in its grave. (20)

Dr. Trowell, a British health officer for East Africa, described a similar syndrome among the Kikuyu tribe in Kenya. He felt, at first, that it was "Infantile Pellagra," but by 1937 recognized that there were the differences which Dr. Williams had pointed out of atypical skin changes and the absence of neurological signs. Not until 1944 did he start calling the disease syndrome by "malignant malnutrition." In 1937, Dr. Trowell added three other symptoms to the list which had never been reported in pellagra--steatorrhea, macrocytic anaemia, and atrophy of the thymus gland. (21, 22, 23)

In 1940, Dr. Trowell correlated findings from Africa with those

of other areas in the world. There was an array of names given to this syndrome: Williams' disease, Kwashiorkor (West Africa), Gillans' oedema (East Africa), nutritional oedema with pellagra, Culebrilla (ringworm) disease (Mexico), Pellagroid-beriberi (Cuba), cheveux blancs (white hair) Belgian Congo, and cachexie hydrique of avitaminesis (Costa Rica). By this time, Dr. C. Williams had described the syndrome among the Malayans and among the Chinese. In Central America, Carillo Gill (1934) and Castellanos (1935) had described it and felt that the etiology was a combined deficiency of vitamins A, B, and C. Meanwhile, in San Salvadore, Goenz (1935) and Bolanos described the same syndrome. Goenz felt that the etiology was a combination of gastrointestinal diseases and parasites which resulted in grave malnutrition. In Costa Rica in 1938, Chavarria and Potter described nutritional edema and felt it was the same as what Goenz had described. They regarded it as a nutritional disorder due to deficiency of protein in the diet. (24)

The pressing question was, "Is this only seen among poorly fed peasants' children of the tropics?" On closer searching, cases were found among war victims and prisons after World War I in starved countries of Central Europe.

In 1921, Dr. Bloch of Denmark described in detail the effects of feeding a liquid carbohydrate diet to infants. These babies developed diarrhea, edema, skin changes in the lumbar region, and cheilesis. (25)

During this same period, Dr. Kohman published a study in the American Journal of Physiology on producing nutritional edema in protein deficient rats. She used 48 rats which had been preobserved and pretested in the laboratory for variables. The control group consisted of two rats only; Group A had 20 rats which received a dry diet with low protein content of 550 grams (dry weight) of carrots, 228 grams of starch, and 120 grams of fat with vitamin A and D complex added; Group B had 15 rats whose diet was the same as Group A except fluids were added freely. The control group had a balanced diet. In Group B, 85 percent developed edema but only 55 percent had edema in Group A and none developed edema in the control group. She repeated her experiment by feeding them high protein diets to relieve the symptoms and then fed them a low protein diet and the symptoms reoccurred. Then she tested each vitamin individually to see if any one vitamin altered the results. She concluded that the vitamins had no effect and that a diet with limited water produced less edema in protein deficiency than those with water. (26)

The relationship between kwashiorkor and protein deficiency went unrecognized by the health officers in Africa until Dr. Trowell correlated them in 1940, in his article, "Infantile Pellagra." (27) He hesitated to diagnose this disease as pellagra after this review because of a fourfold difficulty: (1) the rash, in the opinion of his fellow workers, did not resemble that of pellagra; (2) the edema was

extreme; (3) the cases were acute and often fatal; and (4) there was a high association with other deficiency states and infections. The syndrome was produced during the period of transition from breast feeding to solid foods. Malnutrition occurred where there were food taboos, prejudices, and poverty.

Dr. Trowell experimented with eight children among the Baganda in Uguanda by giving Group I high doses of thiamine; Group II received high doses of nicotonic acid. No other variables were controlled. Both groups were receiving high protein foods. He was unable to derive any substantial conclusion because a great percentage of the patients left the hospital at night without permission. He concluded at this time that the disease was basically pellagra with an associated severe nutritional edema. (28)

Dr. Beatrice Russell in 1946, while working among the Ashanti in West Africa, described again the syndrome of kwashiorkor and related it to the disease Dr. Williams reported. She had treated cases separately with vitamin B_1, vitamin C, nicotinic acid, and riboflavin, and had not found any of them to be curative. She stated that vitamin B_1 and vitamin C sometimes produced a temporary diuretic action and that riboflavin had some effect on healing the stomatitis. She concluded that the best single treatment to bring about recovery was careful feeding. (29)

Dr. Trolli (1938) was the first to report cases of kwashiorkor

among adults in the Congo. He noted no essential clinical differences between the adults and children. The biochemical changes and autopsy findings were very similar. The adults had less edema present, and less depigmentation of both the skin and hair than the children. (30)

In 1945, Drs. J. Gillman and T. Gillman (31) did a noteworthy study of fatty livers associated with "infantile pellagra" in Johannesburg, South Africa. They had developed a technique to assess the liver condition by histological examination of fragments obtained by an aspiration biopsy. They felt that the prognosis of the illness depended directly upon the hepatic injury. Their experiments with animals indicated that they could produce fatty livers by a deficiency of a specific vitamin, but the addition of that vitamin frequently failed to alleviate the pathological process and sometimes even intensified the lesion. In animals, the addition of methionine to their diet proved to be an effective treatment. In children, it produced a toxic reaction.

They studied 23 cases of "pellagrin" children between the ages of one and four years by dividing them into three treatment groups. Group I consisted of seven children all of whom received high doses of nicotinic acid and thiamine. They all died after a few days of treatment. Group II were another seven children who received liver extract by injection; in this group two died, and five recovered in 24-35 days. Group III consisted of nine children who received powdered hog's stomach with 5 cc. of N/10 hydrochloric acid. They

all recovered, after 10 to 21 days of hospitalization. Drs. Gillman reported that the stomach extract produced remarkable lipotropic action on fatty livers. There was a sudden change in the clinical picture; within 24 to 48 hours the edema disappeared. The diarrhea and stearrhea ceased within two to three days. The skin returned to normal within seven to ten days. The child lost his irritability and regained his appetite after a few days of treatment. The physicians regarded this as truly a lifesaving treatment.

Repeated liver aspiration studies were done on all the patients to determine diminution of fat content. Up to 1945, this was the most scientific study done in Africa on kwashiorkor. Trowell tried to repeat Gillmans' study, but he did not know their aspiration technique which made it impossible to do liver studies. He tried treating six patients with stomach extract in 1945 with encouraging results. (32) Gelfand, a government pathologist in Salisbury, Southern Rhodesia, treated seven cases with stomach extract in 1945, and he obtained very poor results. Only one survived; the other six patients died. (33) Powdered hog's stomach was discontinued as an accepted treatment.

Dr. Davies (1948), a pathologist at the Mulage Hospital in Kamapala, Uguanda, did extensive laboratory studies on diagnosed cases. He again confirmed the work of Gillman and Gillman of fatty liver infiltration and did further study of the pancreas on necropsy. He deduced from his findings that pancreatic fibrosis is a lesion of

kwashiorkor. (34)

At Mulage Hospital, where Dr. Trowell was an associate, numerous studies of serum proteins had been done on kwashiorkor children. The serum albumin was grossly reduced, usually below two grams per 100 milliliters. (Normal is four to five grams per 100 milliliters) The serum globulin was often normal or might be temporarily elevated especially during the period of recovery. Dr. Trowell found it difficult to evaluate the findings since surveys on normal African railway employees and soldiers showed a lower serum albumin and a higher serum globulin than was normally found in Europeans. (35)

Davies and Trowell reported early symptoms of kwashiorkor in children, adolescents, and adults. The children had an imbalance of serum protein levels, the light brown, soft curly hair, poor weight gain, and protruding abdomens. (36)

These were the major findings which had been uncovered by 1949 when the Joint FAO/WHO Expert Committee on Nutrition felt a survey needed to be done south of the Sahara to study the etiology of kwashiorkor and diet habits. Drs. Brock and Autret were chosen to conduct this survey. The joint committee recommended an inquiry in these areas: (37, p. 8)

1. A definition of the clinical features.
2. Determination of the incidence of the syndrome.
3. Study of the food habits of the populations among which it

does and does not occur, with particular reference to diet during pregnancy, lactation, infancy, and early childhood, in order to establish a relation between food habits and its incidence.

4. Study of the part played by other factors such as tropical parasitism. (2)

Attention was also given to prevention and treatment of the syndrome.

Drs. Brock and Autret spent two months visiting the larger medical centers, collecting data from discussions and talking with the following types of personnel: hospital assistants, male and female nurses, health visitors, sanitary inspectors, African chiefs and local administrators, missionaries, schoolteachers, school-children and parents at dispensaries and in rural homes. They inquired about children with the symptoms of: nutritional edema; dyspigmentation of skin or hair associated with nutritional deficiency; liver disease of unknown or obscure etiology or nature; and hypo-albuminaemia. They visited baby clinics and young schoolchildren to observe symptoms of malnutrition.

They were able to define the syndrome of kwashiorkor, which is characterized by these ten symptoms: (38, p. 11)

1. Retardation of growth at the late breast-feeding, weaning, and post-weaning ages. This character is fundamental, but is of course also common to such conditions as under-nutrition (lack of calories), marasmus, and atrophy, which cannot be included under the name of kwashiorkor.

2. Dyspigmentation of the hair and to a lesser extent of the skin. It is often faint and may sometimes be entirely absent.

3. Oedema usually associated with hypoalbuminaemia.

4. Pathological changes in the liver which include one or more of the following: fatty infiltration, necrosis, and fibrosis.

5. A heavy mortality if the syndrome is untreated or incorrectly treated.

6. Nutritional dermatosis. This occurs in a variety of patterns but may be absent.

7. Gastrointestinal disorders. These are variable and include one or more of the following: anorexia, digestive upset, diarrhea, mild steaterrhea.

8. Peevishness and mental apathy.

9. Mild normocytic or slightly macrocytic anaemia. The anaemia is commonly severe when the syndrome is complicated by parasitic infestation. If there is chronic blood loss, particularly from ankylostomiasis, the anaemia may become hypochromic.

10. Atrophy of the acini of the pancreas, resulting in decline in enzymatic activity of the duodenal contents. (2)

Another phase of this survey was of the dietary habits. They considered the adults' diet since this was what the children subsisted on as soon as they were weaned. In general, they found that in tribes where meat and milk were common foods, the disease was practically nil, but where yams, bananas, corn, and cassava were the staple foods there was a high incidence of kwashiorkor. The etiology was obviously a protein factor and seemed particularly related to insufficient intake of methionine, one of the amino acids. In most African diets, there are multiple deficiencies: animal proteins; good quality

vegetable proteins, the B complex vitamins, and often vitamin A where palm nuts are not grown.

Drs. Brock and Autret noted that a high incidence of malaria and intestinal parasites were related to kwashiorkor and they felt that these parasites contributed to the etiology of kwashiorkor but that the dietary factor was probably the principle one. From this survey they recommended: (a) the development of animal proteins in Africa; (b) the increase in production of vegetable protein crops; and (c) the augmentation of cash crops. They also recognized the need of an educational program for improvement of feeding methods for children during the weaning period. (39)

In Burundi, shortly after these recommendations were known, the Belgian colonial government constructed small lakes throughout the country and planted a vegetation type fish. Unfortunately, it did not prove to be successful. Torrential rains washed away the dams and small African fish ate the eggs of the planted fish, leaving the lake full of small bony minnows.

Another Africa-wide survey has not been done to reevaluate the nutritional status of Africa. Such a survey would furnish valuable information by showing whether the recommendations of Drs. Brock and Autret have been implemented and what their effect on the incidence if kwashiorkor has been. The survey should also show the number of centers for nutritional rehabilitation for preschool children

which furnish instruction for the parents and their success. There are still areas where dietary educational programs are weak because each area must have the materials adapted to the local situation and because of the vast number of dialects which block communications.

Some Biological Disturbances in Kwashiorkor (40)

In recent years many of the studies relating to kwashiorkor have associated the occurring symptoms to a biochemical process related to a protein deficiency. It is well established that the body is incapable of storing inert protein for emergency use and that, the body's protein is in a constant state of repair and exchange. The nucleotides and structural proteins participate only slightly in this exchange, but tissues involved with metabolic functions are in a constant state of equilibrium. These involved tissues are the liver, pancreas, intestinal mucosa, kidneys, bone marrow, and the plasma proteins. (41)

Waterlow postulated that organs with high protein turnover would show the greatest effect in protein depletion. Early symptoms of protein depletion are detected first in organs with high synthesis and secretion rates of proteins and also in cells with high protein turnover rates. Under conditions of normal protein intake, the liver and the pancreas have high rates of synthesis and secretion of proteins, but the cells are renewed slowly, while the intestinal mucosa

and bone marrow have a high rate of cell renewal. (42) During protein depletion, there are early changes in the intestinal mucosal villi with an associated diminution of lactase activity, an early collection of fatty acids in the liver, an early change in the pancreatic functions, and abnormal plasma protein findings in protein deficient states. The principal symptoms of kwashiorkor are related to changes in these tissues. As the deficiency state is prolonged, other symptoms do occur, but they are usually related to the improper function of one of these organs which has a high rate of protein renewal.

Plasma Proteins

The three major types of plasma proteins are albumin, globulin, and fibrinogen. The albumin is the major portion of the plasma proteins whose function is to transport nutrients and to provide colloid osmotic pressure. A smaller percentage of the plasma consists of the globulins which play an important role in immunity and have other enzymatic functions within the plasma. The globulins are subdivided into alpha$_1$, alpha$_2$, beta, and gamma. The fibrinogen part of the plasma polymerizes into long fibrin threads during coagulation to form the blood clots which repair the leaks in the circulatory system. (43)

The liver synthesizes all of the albumin and the fibrinogen, along with 50 percent of the globulins. The remaining globulin, mainly gamma globulin, is formed in the reticuloendothelial system and

lymphoid tissues. The liver may synthesize four grams of plasma per hour. The rate is determined by the availability of necessary amino acids and the concentration of plasma proteins (44).

Albumin fractions of the plasma are small ellipsoid, single polypeptide chains with a molecular weight of 69, 000. The large number of reactive sites on the molecule makes albumin highly soluble since it may combine reversibly with a large variety of anions and cations. The complexes formed with the anions and cations make plasma albumin assume a highly significant role in the transportation of substances in the blood stream. Among the protein fractions of the plasma, albumin has the lowest isoelectric pH which gives it the ability to bind with cations. These bonded ions are restrained from passing through the capillary walls by nondiffusible negative protein ions (Donnan effect). This characteristic of albumin provides the colloid osmotic pressure effect (45).

The alpha and beta globulins are a minor part of the plasma protein, but they play an important physiological role. The alpha globulin fractions are the glycoproteins and lipoproteins. Among the glycoproteins of the plasma is haptoglobin, which has a high affinity for hemoglobin and forms a hemoglobin-haptoglobin complex with any free hemoglobin, thus preventing urinary excretion of the hemoglobin. The lipoproteins are subdivided into alpha lipoproteins and beta lipoproteins. The alpha lipoproteins are high-density lipoprotein consisting mainly

of the phospholipids, while beta lipoproteins are low-density lipoprotein and consist of cholesterol and of fat soluble vitamins (A, D, and E).

The beta globulin fraction contains glycoproteins, lipoproteins, and two or more metal binding proteins. The most important of these are transferrin and ceruloplasmin. Transferrin (siderophilin) binds with ferric iron and loosely with copper and zinc to prevent toxic concentrations of these metals. Ceruloplasmin is also a beta globulin which is known as the blue protein, since it binds with copper and serves as a transporter for this metal (46, 47).

One of the early symptoms of malnutrition is hypoproteinamia. Reports from many areas of the world consistently associate kwashiorkor with hypoalbuminemia. The gamma globulin levels, however, are normal or increased in association with this nutritional syndrome. The severity of kwashiorkor correlates with the deficiency of plasma albumin (48).

Cohn and Hanson (1962) studied seven children from 9 to 22 months of age with isotopes of iodine (^{131}I and ^{125}I) to observe albumin and gamma globulin metabolism simultaneously. This study was done before dietary therapy. After recovery, the same population was reassessed. This study revealed that the total albumin was reduced 50 percent from the value observed upon recovery. This is a mean of the circulating albumin of 60 percent and the extra-vascular albumin of

40 percent. The mean rate of albumin synthesis was 0.84 grams per day before dietary therapy and upon recovery this increased to 2.40 grams per day.

The level and rate of synthesis for gamma globulin remained unchanged. Whenever gamma globulin levels increased, they did so concurrently with an infection.

The implications of this study are: 1. The degree of albumin depletion may be underestimated since the reduction of the extravascular albumin is proportionally greater than of the circulating albumin. 2. Hypoalbuminemia is the result of reduced synthesis, due not to metabolic blocks but to a deficiency of necessary amino acids. 3. When normal synthesis of gamma globulin occurred in protein-depleted patients who were able to synthesize only one-third of their normal amount of albumin, this indicated that gamma-globulin-forming cells have a particular ability to utilize available amino acids preferentially (49).

Fatty Liver

Fatty liver associated with kwashiorkor was first described by Williams (1933), using it as a distinctive factor differentiating it from pellagra. Dr. Williams described the enlarged liver as pale, fatty and almost diffluent (50). Even though this pathological condition had long been known, it had not helped to solve the etiological problem.

Gillman and Gillman (1945) studied liver aspiration biopsies on 23 infants and children within a few hours of admission to the hospital and found fatty livers to be the most constant pathological condition. Some degree of fatty change was present in the livers of children with mild symptoms. The pathological changes were generally reversible (51).

The principal change in the liver was an enormous enlargement of the individual cells by accumulation of intracellular fat. The livers were generally enlarged, but even when not enlarged the cells appeared the same histologically (52). In a study of the ultrastructural changes in protein-deficient rats, the livers showed a striking reduction in the number of mitochondria and ribosomes and deformity of other cytoplasmic structures. The cystoplasmic structural defects were markedly greater in rats subjected to kwashiorkor than in those subjected to starvation, to chronic undernutrition, or to acute and chronic hepatotoxic damage (53).

Early animal experimentation on fatty livers was done by Best and Hurtsman (1935). They found choline to have a lipotrophic action. They discovered methionine (an essential amino acid) to have the same effect as choline. In rats with fatty livers produced by pure sucrose diets, when 20 percent casein was added to the diet, the fat content in the liver did not increase. When cystine was replaced with a portion of the casein and the fat content increased, cystine was shown to have

an antilipotropic action. Another experiment revealed that a 30 percent methionine-cystine diet was not as effective in prevention of fatty livers as a 30 percent casein diet (54).

In kwashiorkor there are four possible mechanisms for producing fatty livers: 1. Increased mobilization of free fatty acids from the adipose tissue. 2. Increased fatty acid synthesis within the liver. 3. Decreased oxidation of fatty acids. 4. Decreased release of fats from the liver to the plasma in the form of lipoproteins (55).

In normal metabolism glucose inhibits fatty acid release from the adipose tissue, and thus it lowers plasma free fatty acid levels. But in prolonged starvation the free fatty acid plasma levels are elevated because of metabolism of adipose tissue. In a study of kwashiorkor patients by Lewis (1964), the mean plasma level of free fatty acids was elevated to 914 μEq./l upon admission as compared to a control group with a mean plasma level of 367 μEq./l. Upon treatment the mean plasma level immediately dropped to 106 μEq./l, then gradually increased to a normal level by the time the patient was ready for discharge. This depicts increased mobilization of free fatty acids from adipose tissue, but since babies with marasmus (nutritional starvation) have high free fatty acid plasma levels also (815 μEq./l) and do not generally develop fatty livers, this must not be the mechanism. Also, children with kwashiorkor start developing fatty livers before they stop eating. Even in states of starvation the free fatty

acid plasma level never attains the height found in kwashiorkor (56, 57).

Fletcher in his study (1966) with plasma free fatty acids using a labeled ^{14}C-palmitate showed that it was oxidized more rapidly than normal to respiratory CO_2. This would not occur if there were increased fatty acid synthesis or decreased oxidation of fatty acids (58).

A decreased release of fats from the liver to the plasma may arise from reduced hepatic synthesis of plasma lipoproteins or else it may be caused by a deficiency in the lipotropic factors--choline and methionine.

In animal experimentation in producing fatty livers with puromycin, ethanolamine and carbon tetrachloride, the fatty liver results from the reduced hepatic synthesis of plasma lipoproteins. There may be a similar pathogenesis for the fatty liver of kwashiorkor, since there are low plasma concentrations of cholesterol, triglycerides and phospholipids (59) and an indirect evidence for impaired hepatic synthesis of plasma albumin (60).

The other possibility, the deficiency of the lipotropic factors, has never been fully answered. If fatty liver ever results from a dietary deficiency of choline and methionine, it could be expected in kwashiorkor, especially in Africa where the primary dietary proteins consist of legumes which are deficient in methionine.

Truswell did a study (1969) to test these two possibilities of the pathogenesis of fatty liver. Serum was collected on 29 children with kwashiorkor before and during treatment. Paper electrophoresis was used to separate lipoproteins, and the phospholipids were fractionated by thin-layer chromatography. The severity of the fatty liver was determined by needle biopsy. The lipoprotein and phospholipids were compared according to the degree of fatty liver present. The serum albumin, triglycerides, and beta lipoprotein cholesterol (alpha-globulin) showed the greatest difference between the mild fatty livers and the severe fatty livers. The phospholipids were practically the same. The two major fractions of the phospholipids, phosphatidyl choline and sphingomyelin, could be measured quantitatively by thin-paper chromatography. There was no delineation between the mild fatty livers and the severe fatty livers and between the treated and the untreated groups. The percentage of phosphatidyl choline was measured on ten healthy adults who showed a mean of 60 percent. The mean percent for the kwashiorkor group ranged from 55-60 percent, measurements being taken during the course of treatment. These findings indicate that the percentage of phospholipid fraction of the plasma was within normal limits and that the collection of fat in the liver was not caused by the lipotropic factors.

In this study the beta-lipoprotein cholesterol was reduced before treatment with the greatest reduction occurring in severe fatty livers.

The alpha-lipoprotein cholesterol was not consistently reduced but was lower in those patients with extreme hypoalbuminemia.

A test of the pre-beta-lipoprotein was also performed, which showed a simultaneous peaking with serum triglyceride in a fasting plasma during a nonfat dietary regime. This very low density lipoprotein normally transports the triglycerides which originate in the liver. These findings support the hypothesis that reduced hepatic synthesis of the protein moiety of plasma lipoproteins is a major pathogenic mechanism of the fatty liver found in kwashiorkor (66).

Edema of Kwashiorkor

The occurrence of nutritional edema with a decreased plasma protein level has long been known. The edema generally commences when the total plasma proteins are less than 5.5 grams/100 ml, plasma albumin is less than 2.5 grams/100 ml, or the plasma specific gravity (proportional to proteins) is less than 1.023. Since the albumin fraction contributes 80 percent of the effective osmotic pressure of the plasma, a reduction of it produces edema. Each gram of albumin is capable of retaining ± 18 ml of fluid in the blood stream (62).

The simple osmotic effects of low plasma albumin is the most evident etiology of edema but it cannot be the sole factor since marasmic children often have nearly as low levels of plasma albumin as the kwashiorkor children, and they do not manifest edema (63).

The level of serum albumin fails to correlate with the degree of clinical edema (64). The children with edema all have a low plasma protein level, but some of the kwashiorkor children with extremely low plasma proteins do not have edema (65).

Other possibilities for fluid retention have been researched, especially by Srikantia and Gopalan in India. Gopalan hypothesized that the fluid retention is caused by the fatty liver's incapability to inactivate the antidiuretic hormone of the posterior pituitary gland. This does not explain how high levels of antidiuretic hormone can be maintained over long periods of time since it has a short half life (66).

Ferritin, the iron-protein complex for iron storage, can under certain conditions exert considerable antidiuretic activity. It was first found to be increased in eclampsia, nephrotic syndrome, and hepatic cirrhosis (67). Srikantia demonstrated active ferritin in the circulation of kwashiorkor children and of adults with nutritional edema. The ferritin disappeared after treatment. But in children with marasmus, ferritin could not be detected in their blood.

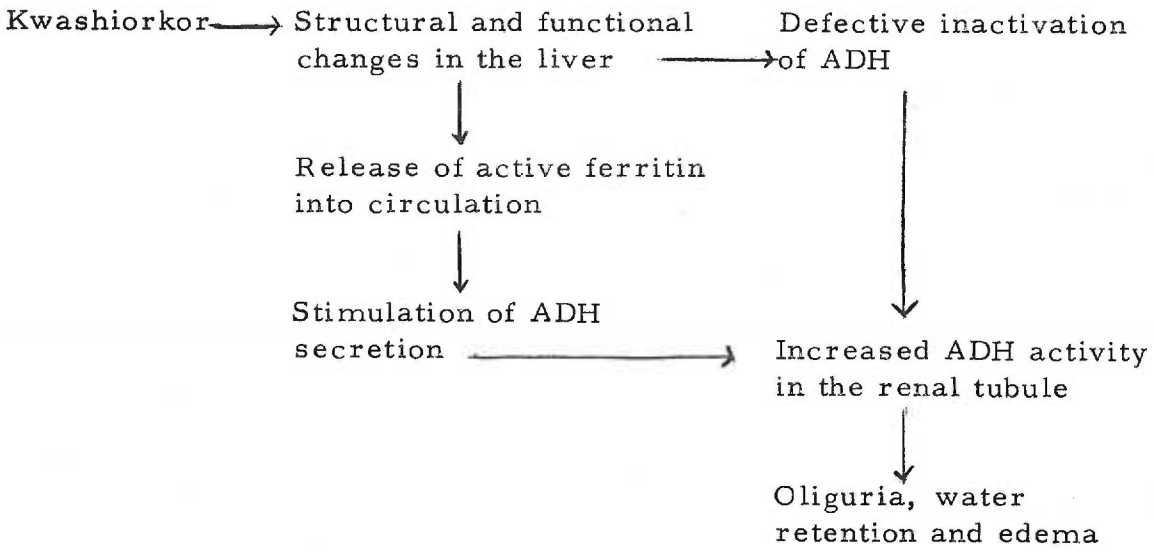
It was demonstrated that the antidiuretic action of ferritin is mediated through the posterior pituitary and depends upon the presence of ferrous iron on the surface of the ferritin molecule. Oxidation of the ferrous ion to the ferric forms physiologically inactivates ferritin (68). These findings were also confirmed by Srikantia (69).

Srikantia produced protein deficiencies in 12 monkeys. Six of these were given supplements of aureomycin which deranges the metabolism of hepatic ferritin and prevents circulating levels of ferritin in the blood. The six monkeys on aureomycin supplements did not develop edema but the other six did.

Srikantia had determined renal function on both kwashiorkor children and adults with nutritional edema and had found neither the renal plasma flow nor the glomerular filtration rate to be abnormally low. The urine volumes were markedly decreased, which indicated an increased tubular reabsorption of water. Increased tubular reabsorption involved increased aldosterone activity. Increased aldosterone had not been found in kwashiorkor.

Another etiological factor in the edema of kwashiorkor could be elevated plasma cortisol levels. Though the cortisol level is elevated in kwashiorkor, it is equally as high in marasmus, where no edema is present (70).

On the basis of these considerations, it would appear that the causative factor of edema in kwashiorkor could be shown by this diagram (71):



The Pancreas and Gastro-Intestinal Symptoms

The first detailed description of the pancreas in kwashiorkor was made by Dr. Davies in 1948 (72, p. 318):

> The earliest histological changes in the pancreas appear to be atrophy of the acinar cells with a diminution in the numbers of secretory granules . . . . The next stage is more definite: the cells undergo hyaline changes, the tubules are dilated, and a periacinar, intratubular, and perilobular fibrosis begins. There is also a periductal fibrosis. Iron pigment is not seen. The effect is that the acinar tissue is broken up by the fibrosis, and the lobular outlines are shown up by dense bands of fibrous tissue. In advanced cases the acinar tissue disappears over wide areas of the pancreas; the islets are affected, and some seem to disappear.

A study was done in 1966 at the University of Kansas of the pancreas in a proteindeficient Rhesus monkey; electron microscopy was used to follow the pancreatic changes. The acinar cells were grossly atrophic with loss of the normal cell architecture, particularly of the rough endoplasmic reticulum. The endoplasmic reticulum

was irregular and focally dilated with a diminution in the number of ribosomes. There was an apparent loss of normal zymogen and prozymogen granules, which were replaced by irregular vacuolar bodies. Multiple foci of cytoplasmic necrosis were present, often involving the greater portion of the cytoplasm. The investigators found the pancreas to be the most severely altered organ in the monkey (73, 74).

The loss in the zymogen and prozymogen granules suggests a morphological defect in the secretion of pancreatic enzymes (75). Davies (1948) postulated that the pancreas is the organ primarily affected in kwashiorkor. He reported cases where the liver changes were reversed without clinical improvement, suggesting the major pathology to be pancreatic in origin (76).

Studies by Veghelye in Budapest during World War II, when milk became unavailable, revealed that within three weeks there was a fall in the enzyme activity of the duodenal juice. Lipase and trypsin were the first to fall, and later amylase. These changes occurred before malnutrition was severe and before there was evidence of liver damage (77).

Barbezat (1967) investigated the exocrine function of the pancreas in five groups of children: 14 kwashiorkor children with a mean age of 25 months, 7 marasmic children with a mean age of 25 months, 11 kwashiorkor children who were reinvestigated after

treatment, 8 control children with a mean age of 23 months, and 10 children with chronic malnutrition with a mean age of eight and one-half years. Pancreatic functions were stimulated by the intravenous administration of the hormones, secretin and pancreozymin. The volume, the pH, and the enzymes amylase lipase, trypsin, chymotrypsin, and ribonuclease were observed. The results demonstrated that the volume output and the ability to raise its pH remained unaffected but certain individual enzymes were deficient. Chymotrypsin was the most sensitive, while trypsin was least affected.

The kwashiorkor patients who were reinvestigated showed a complete recovery of pancreatic functions. There was a negative correlation between the level of pancreatic function and the serum protein level. In reinvestigating the chronically malnourished, even after prolonged dietary therapy, it was found that their pancreatic function did not return to normal. It was postulated that the chronically malnourished children have irreversible damage (78).

Atrophy of the gastro-intestinal tract is a prominent feature in protein depletion since a high rate of cell renewal of the mucosa is normal. The cells of the crypts of the small intestine continue to proliferate, but the cells which line the villi do not. The crypt cells become very vulnerable to protein depletion, cytotoxic drugs, and irradiation.

In a study of jejunal biopsies of kwashiorkor patients at Mulago

Hospital, Kampala, Uganda, Stanfield reverified the abnormally thin mucosa which Trowell reported (1954). He further described the abnormal villi which join in ridges rather than form the complex convoluted pattern normally seen. From 16 biopsies, the villi-crypt ratio was abnormal. The normal villi-crypt ratio is 2.0, but these biopsies had a 0.1 ratio. Repeated biopsies of four patients, done one month after treatment, showed no appreciable improvement (79).

Mucosal-enzyme assays were done for lactase, sucrase, and maltase. In the grossly abnormal mucosa the enzyme levels were extremely low. The levels tended to be nearly normal where the mucosa was not severely damaged. The lactase levels were the lowest and might not return to normal upon treatment, but the other disaccharidase levels resumed normal activity upon treatment (80).

Extensive lactase activity studies have been done by Holzel (81), Cook (82, 83), Bowie (84), and Prinsloo (85). These relate interesting findings in relation to the persistent diarrhea of kwashiorkor.

The enzyme beta-galactosidase, which hydrolyzes lactose to form glucose and galactose, is missing or has lowered activity in kwashiorkor. The enzyme is secreted from the brush border edges of the mucosal villi in the jejunum.

Lactose intolerance is found more frequently among the Orientals, American Negroes, Greek Cypriots, and Bantu Africans

and rarely among the Caucasians (86, 87). Cook studied 72 Bugandan newborn babies and infants. He concluded that lactase activity is normal at birth and gradually decreases, reaching intolerance levels by three to four years of age. He found the same decline among orphans who continued to drink milk past the ordinary weaning age. This suggests a genetic basis for the fall in lactase activity (88).

Bowie reports 65 percent incidence of lactose intolerance in his study of 20 kwashiorkor children (89). Cook found only 34 percent absorption rate among kwashiorkor patients as compared to a 75 percent rate for the normal adult (90). The absorption rate for lactose does not improve with treatment. Bowie followed his study for one year and found no improvement in the absorption rate after one year (91).

Cook hypothesized that children with low lactase activity levels during infancy are predisposed to kwashiorkor. The disproportional lactase deficiency without doubt has a genetic basis, but additional factors are malnutrition and intestinal infections (92).

Amino Acid Metabolism

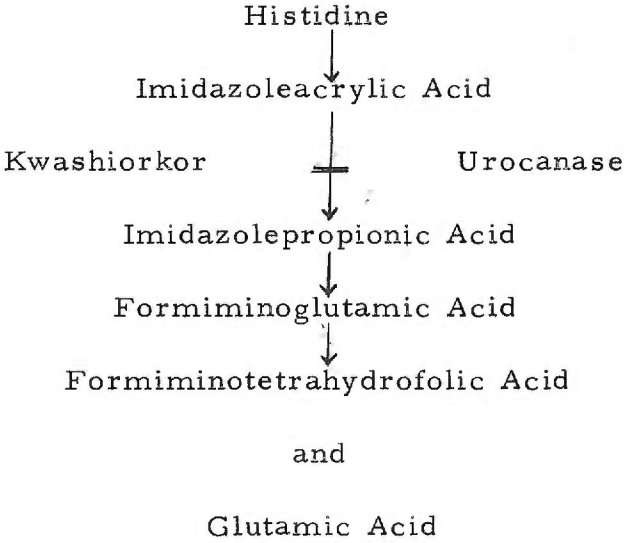
Several of the amino acids show defective metabolism in the more advanced stages of kwashiorkor. With paper chromatography of urine, imidazoleacrylic acid, an intermediate in the catabolism of histidine, was the first one to be found. A study was performed

of males from the age of 12 to 30 months with kwashiorkor to detect intermediate metabolites of histidine. Upon admission to the hospital, a 12-hour urine specimen was collected and studied; then repeated urinary studies were done through the treatment to assess the histidine metabolism (93).

There was a close correlation between the excretion of imidazoleacrylic acid and the severity of kwashiorkor. With treatment the histidine metabolism returned to normal. This finding is thought to be produced by decreased activity of the enzyme, urocanase, since the intermediate metabolite, formiminoglumatic acid, which results from this reaction, is not found in the urine.

Histidine was also excreted after large doses of l-histidine, which would indicate reduced activity of the enzyme, histidine deaminase.

This diagram summarizes the metabolism of histidine in kwashiorkor.



It was suspected that there might be abnormalities in phenylalanine and tyrosine metabolism also. Test doses of phenylalanine were given to severe kwashiorkor patients, and they excreted phenylpyruvic acid in their urine, but the same children did not excrete it after treatment. The severely ill children could not catabolize tyrosine. After test doses of tyrosine were given, they excreted p-hydroxyphenylpyruvic, p-hydroxyphenyllactic, and p-hydroxyphenylacetic acids.

This metabolic defect does not account for the blond hair and the mental changes since the occurrence of the defect develops after the occurrence of those symptoms. But after this abnormality occurs, it could accentuate the symptoms of hypochromotrichia and apathy (94).

Studies of tryptophan metabolism were performed by giving test doses to nine marasmus children, nine kwashiorkor patients with dermatosis, six kwashiorkor patients without dermatosis, and seven control children. The marasmus children retained the greatest amount of tryptophan metabolites (5.58 mg/kg of body weight), followed by the kwashiorkors without dermatosis (3.97 mg), then the kwashiorkors with dermatosis (2.85 mg), and the control group retained the least (0.04 mg).

When the retention of tryptophan metabolites were investigated after test doses were given to patients in a negative nitrogen balance, the metabolites appeared to be used first to establish and maintain

nitrogen balance and then were used for synthesis of pyridine nucleotides. This study showed that the marasmus and kwashiorkor children without dermatosis were best able to utilize tryptophan. A second set of test doses with pyridoxine (B_6) was given to the children with the dermatosis, and it improved the retention level of kynurenine, an intermediate metabolite. This improvement is attributed to reactivation of partially inhibited B_6-dependent enzymes. The defect is this enzyme may be partially caused by pyridoxine deficiency (95).

Skin and Hair Changes

The "crazy pavement" dermatosis of kwashiorkor was classically described by Williams (1933) as an important clinical feature distinguishing it from pellagra. But very few studies of biochemical changes in the skin have been done until research by Vasantha in India (96, 97).

Vasantha's studies showed that children with skin lesions have decreased levels of collagen. She studied biopsies of skin from 19 children with kwashiorkor and 10 normal children. The kwashiorkor children were classified in three groups: kwashiorkor without dermatitis, kwashiorkor with dermatitis, and kwashiorkor after treatment. The collagen nitrogen was the lowest (5.86 gm./100 gm. of defatted tissue) in patients with "crazy pavement" dermatitis, and was subnormal in the ones without dermatitis (7.78 gm.). But the patients after treatment had levels higher (11.17 gm.) than the control group

(10.66 gm.). The noncollagen nitrogen content was also lowered but not to the same degree as the collagen nitrogen. The dermal nitrogen had greater reduction than the epidermal nitrogen. This study showed a preferential loss of collagen (98).

The amino acid percentage of dermal nitrogen was also studied. In addition to hydroxyproline, the concentrations of three other amino acids, proline, glycine, and tyrosine, were markedly reduced. The lowered level of tyrosine indicates defect in maturation and structural integrity of the collagen fibers. This amino acid plays an important role in fibril aggregation. These findings of low hydroxyproline and tyrosine levels indicate that the dermatitis associated with kwashiorkor is related to the lowered amount of collagen and to its structural immaturity. These changes lead to impaired integrity of the skin especially in areas where there is mechanical stress. From clinical observations, the "crazy pavement" dermatosis are found in areas where the skin is subjected to pressure. The deficiency of collagen alone would not produce the dermatosis without the associated lowering of tyrosine (99).

The depigmentation of the skin, which produces a reddish cast to the negroid skin, is described in the very name kwashiorkor, which literally means "that red boy" (100). The dermal depigmentation is probably biochemically related to tyrosine deficiency of the dermal tissue or to an enzymatic deficiency in tyrosinase to polymerize

tyrosine through a series of oxidative steps to form melanin (101).

A variable feature of kwashiorkor is the change in the hair. The hypochromotrichia, loss of natural curl, brittleness, and sparseness of hair, form a more frequent syndrome in negroid infants than in other ethnical groups (102).

There is considerable disagreement in the findings of research done on the hair in kwashiorkor children. Some factors influencing the findings are the ethnic differences, the analytical techniques, and inadequate controls (103).

The sulfur-containing amino acids, cysteine and methionine, are important in the nutrition of the skin, nails, and hair. There is a narrow region known as the keratogenous zone, located under surface of the hard tissue in the skin and nails. This zone is enriched in sulfur content (104). The keratin cells are formed in this area. These cells (or fibrils) migrate outwardly forming disulfide bridges from the oxidation of the sulfhydryl groups of the cysteine residues. The disulfide bonds cement the smaller molecules into a solid mass which gives keratin its strength and impermeability qualities. Oxidized cysteine residues comprise nearly one-fifth of some keratinous tissue (105).

The enzymes for catalyzing these reactions are unknown, but it is thought that the trace elements of copper and zinc are needed for healthy growth of the nails and hair. But their functions have not yet been established. Bradfield studied hair zinc levels in Andean Indian

children and found no differences between normal, kwashiorkoric, and marasmic hair (106).

In animal experimentation it has been shown that low cysteine diet affects the growth, texture, and color of sheep's wool (107). With disagreement in the research findings among kwashiorkor children, nothing has been established related to the biochemical disturbances causing hair changes. It appears that cysteine metabolism in the formation of keratin plays an important role in the curl, brittleness, and sparseness of the hair, while the color change is related to the oxidation of tyrosine in the formation of melanin.

Summary

The early health workers of Africa confused kwashiorkor with pellagra. Dr. Williams (1933) first described kwashiorkor and observed that the syndrome developed when breast feeding was discontinued, and while the child was receiving a high carbohydrate diet. It was not until the Joint FAO/WHO Expert Committee on Nutrition commissioned a survey of kwashiorkor in the countries south of the Sahara that the etiology and symptoms were clarified.

The research during the past twenty years has been directed toward the biochemical aspects of protein depletion. The organs and tissue with high protein turnover are where the first symptoms of kwashiorkor are manifested. The target areas of protein depletion

are the plasma proteins, the acinar cells of the pancreas, the liver, and the intestinal mucosa. The intricate interreaction between these tissues during depletion produces the symptoms of fatty liver, edema, and the malabsorption syndrome.

The enzymatic defects in the metabolism of histidine, phenylalamine, tyrosine, and tryptophan occur in severe depletion states. These defects appear after the symptoms of mental retardation and depigmentation and are not the etiological basis of these symptoms.

A reduction of nitrogen in the dermal collagen and a reduction of the concentration of tyrosine content of collagen impair the integrity and maturation of the skin to provide the dermatosis of kwashiorkor. The depigmentation of the skin and the hair changes are not fully understood. Ethnic differences, imperfect analytical techniques, and inadequate controls have impaired research efforts in clarifying these symptoms.

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CHAPTER III

BURUNDI AND ITS CULTURAL SOCIO-ECONOMICAL INFLUENCES TO A HEALTH PROGRAM (108)

Introduction

Burundi is a well-favored region with beautiful scenery; its high green hills and mountains, well watered and fertile, its fair valleys and plateaus are aptly called the "Switzerland of Africa." An area of only 10, 774 square miles contains a population of 3.4 million Barundi (109). This makes it a very densely populated area of Africa.

This small independent Republic is located right in the heart of Africa, two degrees south of the Equator, on the northeast end of Lake Tanganyika. It is a landlocked country with the Democratic Republic of Congo to the west, the Republic of Rwanda to the north and Tanzania to the east and south.

The country is geologically astride the Congo-Nile divide and along the crest it attains an altitude of 8, 500 feet (110). The western section of Burundi along the Ruzizi River and Valley forms a portion of the western section of the great Rift Valley. The water from the high hills of the central and northern sections of Burundi drain into the

Nile Basin, while the water from the western hills and the south-eastern and the mountains of the extreme south drain into the Congo Basin. The southern-most source of the Nile River is a small mountainous spring in the high hills of Bururi Province which before leaving Burundi has grown into the treacherous Ruvuvu River; in Tanzania it joins with the Kagera River before flowing into Lake Victoria.

Population

Among this population of 3.4 million Barundi, there are three ethnic groups, but they all speak the Bantu dialect of Kirundi. Fourteen percent of the population are Batutsi, a tall pastoral people of Hamitic origin who arrived in the country several centuries ago. The majority (84 percent) of the population are Bahutu, a stocky, medium-sized, agricultural people who occupied the country long before the Batutsi came. The remaining two percent of the population are the Batwa, the pygmies, who probably dwelled in the forest areas before the forest disappeared. Now they dwell among the Bahutu in small villages. They were migratory like other pygmy tribes until recent years when land became a premium. They monopolize the industry of manufacturing the hand-molded clay pots used by every household as cooking, water, or beer pots (111).

Burundi is one of the most densely populated areas south of the

Sahara, with 311 people per square mile. The rate of population increase is two to three percent annually. If it continues at this same rate, the population will double in another generation. Children and adolescents comprise 55 percent of the present population (112).

Burundi is a country without villages; the houses are located among the groves of bananas. The population is the greatest where the banana groves are numerous. During the Belgian Colonial Rule, the administration had campaigns for the people to build their homes along the road but they refused to conform. Building away from the roads with a protective hedge surrounding the house affords safety. Houses built along the roads are more vulnerable to thieving.

There are very few urban areas; the principal one is the capital and port city of Bujumbura. The estimated population in 1969 was only 67,000 (113). The other urban areas are the former Belgian administrative centers; these areas are very small, not exceeding several thousand in population.

History and Present Government

The ancient country of Burundi became a kingdom centuries ago, after the Batutsi tribe migrated from the Galla Plateaux with their cattle. They bargained peacefully with the Barundi to occupy the high hills of Burundi. According to tradition, the Hamitic peoples traveled in stages from the North Africa to central Africa. They remained in

an area until the pasture land was exhausted, sometimes staying for centuries before moving on south. Traces of their powerful kingdoms were left behind and their racial traits are in the ruling families of those areas in which they lived (114).

The lyre-shaped horns of their cattle resemble those depicted in the ancient monuments of the Egyptians. The Batutsi herdsmen still revere the cow in a similar manner as the Egyptians venerated the Bull Apis (115).

When arriving in Burundi, the Batutsi readily deceived the Bahutu (a Bantu agricultural tribe then occupying the country) by asking for the use of the high hills as pasturage for their cattle and promising the Bahutu calves in return for their services as gardeners. The system was established in such a way that the Bahutu seldom, if ever, completely gained ownership of his cow, though he labored perpetually for it. This developed into a modified feudalistic system somewhat similar to that of medieval Europe but based on cattle-holding (116).

The longhorn cattle became the criterion of a person's wealth. Even today the Batutsi defend their herds with their life, if need be. They face great hunger rather than kill a fine ox, without which the family's capital would be impaired. One elderly couple recently had died of starvation, leaving a herd of 50 cattle.

The ancient kingdom of Burundi was colonized originally by the

Germans. After a group of German explorers and botanists traveled across Central Africa, a lively interest in the mysterious heart of Africa was engendered by these men, causing the Germans to push foward briskly to colonize this area during the years of 1907 to 1914.

World War I was fought in Africa, as in Europe. There were fierce conflicts on the Congo-Rwanda border and the Uganda-Rwanda frontier. As a recompense for Belgium's contribution to allied victory in Africa, she was entrusted with the Mandate of Rwanda and Burundi (Ruanda-Urundi) under the auspices of the League of Nations. Burundi was a mandate territory of Belgium, administered under the Belgian Congo codes until Independence on July 1, 1962.

During the years of colonization the rule of the King (Mwami) continued and received but slight interference from either the German or Belgian administrators. The King was held in highest awe, fear and reverence. The Belgians used the tribal courts, chiefs, and subchiefs for governmental control, making them responsible to Belgian officers.

The ruling dynasty reigned for more than four centuries. The crown was passed to a male heir of the king, who assumed one of the four dynastic names--Mwambutsa, Ntare, Mwezi, Mutaga--upon being crowned King. The Burundi king, (Mwami), was less absolute than the neighboring king in Rwanda. The former shared power with a class of semiautonomous Batutsi nobles who were the chiefs (Ganwa)

and the subchiefs (Tware). The nonroyal Batutsi were aristocrats but did not have the prestige the Batutsi had in Rwanda (117).

On July 1, 1962, when the country became independent, the Government was a constitutional monarchy with power divided between the Mwami with his royal court and an elected National Assembly of representatives. The first Prime Minister elected was the king's son, Louis Rwagasore, who was assassinated before taking office. This marked the beginning of a tumultuous chain of events which included several assassinations and attempted "coups d' etat." The Mwami often resided in Switzerland for the fear of his life, returning to the country unannounced and remaining a very brief period. He was not in the country during the most violent "coup d' etat" where violence between the Batutsi and Bahutu classes persisted for months, ending in the deaths of many educated Bahutu. Biha, the Prime Minister, who was seriously wounded during the "coup d'etat" went to Europe for medical care and the Crown Prince, Charles, attempted to rule by proxy in the absence of his father. This was unsatisfactory. Prince Charles overthrew his father on July 8, 1966, and was crowned Ntare V on September 1, 1966. On November 28, 1966, Ntare V's three month rule came to an abrupt end when, in his absence, his Prime Minister, Captain Michel Micombero, overthrew the government, proclaiming Burundi a Republic, himself the President, Prime Minister, and Chief

Executive of the Army for a self-elected seven-year rule to avoid elections. The executive and legislative power is centered in a twelve-man National Council of Revolution who are appointed by the President. President Micombero also became president of the single legal political party, the "Parti de l'Unite et du Progress National du Burundi" (UPRONA) (118, 119).

The country has remained under the rule of President Micombero since 1966 with relative peace in the country. Several attempted "coups d'etat" have all been stopped before they have seriously impaired the government.

The Economy

The funds for governmental operation are obtained through taxation and tariff revenues. Each male pays a head tax of about ten dollars annually and each cattle owner pays a tax of one dollar per head of cattle. The professional personnel pay an income tax according to their salary. Most of the finances are obtained from duty on imports (120).

The principle export is coffee as Arabian coffee has a good world market. The other major export is cotton for the fiber of this cotton is an excellent grade. Other exports are hides and tea (121).

The labor force is predominantly unskilled with 95 percent of the people engaged in agriculture (122). The average annual income per

family is $53.00. This is one of the lowest in the world.

The medical and the education programs are very highly subsidized by Belgian and other foreign aid programs. Any developmental program is funded by foreign aid. Belgium and West Germany have had strong technical assistance programs. The Food and Agriculture Organization of the United Nations has assisted with agricultural development by research and education of technicians.

The Climate and Vegetation

Topography

The climate is salubrious without excessive heat, owing to the average altitude of 5,000 feet. The prevailing temperature is similar to a warm summer day in the Pacific Northwest, with cool mornings and evenings and often chilly nights.

The mountain tops, where there are jungle-like crevasses in which small remnants of the primitive forest still persist, are probably where the ancient tribal chiefs lived. Along the ridges of the hills are where the cattle grazed. At the turn of the century these hills provided rich pasture land but now many of the hills are eroded and nearly barren because of over grazing. Around the Ruvuvu River, where it is not over-populated, lush pasture lands still exist. The grass is burned from the hills once a year to offer tender young

blades for the cattle.

Lower on the mountain sides are the cultivated fields of the Bahutu. Groves of banana trees surround their dwellings. Among the bananas and in the surrounding fields are plots of beans, sweet potatoes and manioc.

In the valleys and in some of the high hills are numerous springs of clear, sparkling water issuing from the earth, merging into small streams, rushing between brushy banks, collecting red soil as they move along, and finally flowing into the winding, curvy, muddy rivers. The valleys determine the size of population living in an area, since the dry season crops are planted in the valleys and irrigated from these springs and streams.

Seasons

The main dry season begins in either May or June and lasts until September or early October. During this period the green hills quickly fade leaving only the green banana groves. The roads are soon a cloud of red dust raised by every passing vehicle. The early mornings are chilly with a piercing cold wind which prevails until about 10 A.M. The sky is over-cast with false rain clouds until mid-morning when the sun finally makes its appearance. The hazy atmosphere makes the hills a few miles away invisible. As the dry season ends, the winds lessen and the temperature rises. These are

welcome signs to the Murindi for he knows that the rains will soon start. The crops he can raise in the valley are sparse and his supply of beans from his main harvest in June is diminishing.

After several good rains in September or October, the Barundi begin planting beans and corn, moving sweet potato vines from the valley, and planting the cuttings on the hill sides. In a short time the hills are green again with fresh, tender blades of grass for the herds of cattle.

The rains are light. There is apt to be a hard electric shower for an hour in the early afternoon, after which the sun reappears. This makes the atmosphere clear and clean and the hills visible for many miles. In January there is another very short dry season. Some years it is hardly noticeable, other years two or three weeks may pass without any rain.

The rains of February are pleasant, often occurring during the night and usually very soft and gentle. The hills are again prepared for planting. This is a busy season, even the men will help their wives with the digging because every plot of available land is planted to beans. They have until late March to finish the planting.

In April, there is a lull before beginning the harvest season of May and June. April is the month of heavy destructive rains. It may rain torrents for several hours at a time. This washes away much of the top soil into the valley, leaving gulleys behind and often washing

away the newly sprouted beans as well.

Harvest

As soon as the rains decrease, the millet is ready for harvest. This is a tedious task, cutting each head by hand with a small knife. Before the millet becomes useable, it must be dried in the sun, beaten to remove the outer husk, then ground by hand on a grind stone.

By the middle of May the coffee beans are red and are ready for harvest. The men help the women to harvest coffee, since it is a cash crop. Coffee harvest requires much hand labor. The picking and the husking of the outer shell are all usually done by hand. Mechanical huskers are available in many places. The coffee must be brought to the designated places where it will be husked free. Unless a farmer has a large quantity, it is more efficient to do it by hand. After the husking is finished, the coffee bean is dried in the sun for several weeks until it is extremely dry, then it is marketed.

Coffee is bought by the local African, Indian, or Greek traders, who then transport it by truck to Bujumbura where it is sold to processing plants. In these plants, the coffee is prepared for export. This Arabian mountain grown coffee is of high quality and has a ready demand in the world market. Coffee is the principle export product and the main source of cash for the average Murundi.

Before the coffee harvest has been completed, the beans are ready for gathering and the sweet potato vines must be moved to lower areas near the valley before the rains stop. The manioc shoots are also planted in early May, but they require two years to produce large edible tubular roots.

In May and June the women are extremely busy with the harvest. When the harvest is completed the valley garden must be prepared for the dry season crop of beans. The men must cut the brush and grass from the valley or furnish a workman to do it before the women begin cultivating.

Banana trees bear all year round, but the heaviest harvest is during July. There are three major types of bananas: the cooking banana, which is cooked green with either dry beans or peas; eating banana, which is picked green then allowed to ripen in a cool shady place; and the beer banana, which is over-ripened before making into beer.

Other minor crops which are grown are: peas, peanuts, corn, kaffir corn, and wheat. The common vegetables which are grown are onions, leeks, eggplant, cabbage, and carrots. Fruit trees are not commonly grown but there are some oranges, papayas and avocados. Pineapple fields are also found among the more progressive Africans. All of these products are marketed to provide cash. Tomatoes may be grown during the dry season but are blighted during the rains. Other

fruits and vegetables can grow well in Burundi but have not been accepted by the Africans.

In the hot dry Ruzizi valley, which extends from the north end of Lake Tanganyika, are many fields of cotton. Each African has a field of cotton which is cultivated and harvested by hand. Large semi-trucks collect the cotton from the rural areas and transport it to a factory in Bujumbura. The cotton is the second largest export for the country.

Livestock

There are 583, 400 head of long horn cattle in Burundi which have a very low milk production. The cows barely produce a liter of milk each day above the needs of their calves. Young steers are seldom slaughtered for meat, only the older cattle which can no longer climb the hills to graze. The Bahutu, especially, have small herds of goats and sheep (123). The goats are of a small stature and produce milk only for their offspring. Improved breeds of milking goats have not been introduced into the country for the fear of spreading Brucellosis. Goats are butchered and sold for meat at about 60 cents per kilogram. Sheep are seldom eaten. They are used for religious rituals, or as lead animals to guide their herds to the pasture lands, or sold to the Mohammedans for cash.

Chickens are commonly grown but they are a type of game fowl

with very poor egg production. Those families who have excess eggs seldom use them but sell them to more elite families for needed income. Chicken is eaten but again the poorer families will sell them instead of consuming them.

Improved breeds of chickens are being introduced and very good offers are given through the experimental farm to those who will care for 50 chickens for egg production. This presents the problem of feeding the chickens. Game chickens are raised on open range and do not cause destruction of the garden except during very brief periods when the beans are young. However, improved breeds raised on open range cause serious garden damage and this kind of feeding impairs their egg production also. The grain supply is limited and is expensive to purchase for chicken feed.

Water Supply

Water for domestic use is carried from small springs usually located in the valleys. The springs have often been improved to assure safer drinking water. If homes are located in areas without improved springs, the families dip their water from open streams. This water is often cloudy with large amounts of sediment. The very educated families are the only ones who boil water for drinking. Sometimes leeches are consumed by drinking water from poor sites. Ameobic dysentery and other intestinal parasites are contracted from

unboiled drinking water. At medical centers and secondary schools there are diesel pumps and storage tanks on towers to furnish tap water. When the government has finances to operate these systems, the tap water is available for the total population of that area.

Housing

Because of the scarcity of thatching grass, the grass huts have nearly all been replaced by other types of structures. It is even difficult in many areas to obtain enough grass for the roof. The poorer people build with a mud and wattle construction while the more industrious people build with sun dried bricks. Some wealthier men build with burned bricks on stone. The soil in many areas is suitable for making firm durable bricks. Both the mud and wattle and the sun dried brick homes are comfortable, warm homes if built well.

Building the walls is usually very inexpensive. The roof, the doors, and the windows are the most costly to build. The windows are ordinarily very tiny to lower expenses and to provide protection from thieves. The doors are hand made with hand sawed cedar lumber. The roof is thatched with grass, with banana bark, or roofed with galvanized tin. The tin is expensive but it is purchased if the family has employment. The floors are made of a firmly packed dirt; only rarely does a house have a cement floor.

Termites are a constant problem in nearly every area of

Burundi, and they cause extensive damage to the homes. The white ants eat their way up the walls to the rafters and thatching materials, leaving holes behind. The rafters are soon weakened and break under the weight of the roof. The grass or banana bark thatch or the supporting reeds are riddled by the ants, causing the roof to sag and leak. If the house is not plagued with termites it will last 20 years, and a good thatch roof will last eight to ten years, but where termites are a problem, the life of the house and especially the thatching is shortened.

Marriage and Family Life

Heritage

The son in this patriarchal society builds his home beside his father and brothers. The father usually gives him a plot of land for tilling unless he himself does not have sufficient acreage. The son has to buy more land for cultivating as his family increases. Upon the death of the father, the remaining land is divided between the sons and any unmarried daughters. If the son is raised by a maternal grandparent or by a friend, he does not share in the inheritance.

Marriage Preparation

The young man begins to prepare for marriage at the age of

15 or 16 unless he is in school. In such a case, he starts the process upon graduation or dismissal from school. During this period of preparation, he builds his house and saves money for the dowry. Often his father will help him obtain the dowry and will even provide a young cow if he has a few head of cattle.

The dowry usually consists of about $20.00 to $40.00 plus a young cow. The price depends upon the education and qualities of the bride. The dowry is the stabilizing factor in the marriage because the father of the bride must repay the dowry if his daughter later separates from her husband. Likewise, the husband can not readily obtain this sum of money to purchase a new wife.

When the home is nearly completed and the dowry money is forth coming, the young man starts asking for the girl he has chosen. The qualities he looks for in a girl are her ability to work, her meekness of spirit, her obedience, and her fidelity. He finds these out by sending friends to her community to ask the people who know her well about her qualities and character. When he finds a girl who appeals to him and who is of good report, he starts proceedings to obtain her as his bride.

Girls who are boisterous and foward or lazy, usually are not married until later in life, then only to elderly men or as a second wife.

The groom chooses a "go-between" who goes to the girl and her

father to ask them if they would consider marriage with this young man. Either the girl or the father may refuse, though sometimes the family will pressure the girl to marry if it is a promising marriage. They return the decision to the "go-between" and he starts bargaining for the dowry price. At this point, two people will usually go in order to have a witness to the price which was decided.

In the past, the young man and girl were never to speak alone or be seen alone together before their marriage. This custom is breaking down with the influence of Western cultures. In urbanized areas it is not uncommon to see courting; but many times the girl who is courted is not taken as the bride. The young man will usually seek a girl with less education from a rural area because he is more interested in a girl who is faithful, obedient, and a hard worker than in the qualities of city girls.

The educated girls are often left unmarried because they are too forward and the men are afraid that they will be unfaithful. They may fear her inability to work the garden if she has been sent to school and has not grown up beside her mother's hoe.

Marriage Ceremony

When the dowry is completely paid, the bride and groom with their close friends go to the local communal government to have their marriage recorded. Following this they may have a church wedding or,

if they are of no faith, they just have the wedding feast. In church marriages often the "elders" of the church meet the the couple before the marriage and the bride and groom make promises to each other in the presence of the "elders". The man starts by asking his bride questions: "Will you take care of me when I am sick?" "Will you welcome my friends into our home?" "Will you cook me food when you are tired?" and other similar questions. The bride's questions are related to fertility or permission to visit and care for her family. These promises may be used in later years if the couple is having marital problems.

The groom provides the bridal clothing and a complete new wardrobe for the bride. All of her old clothing is left at home for her sisters and friends. She is not to take anything from her father's home to furnish the new home.

The feast is provided by the groom. The husband brings the bride to the new home where the feast has been prepared. He takes her to their bedroom; there she stays with her bridesmaid. When the food is brought the groom and best man come to join them in eating the feast. The guests eat in the front part of the house and the courtyard. The guests may be very rude to the groom and complain bitterly if the food is not plenteous or if the presweetened tea is not sugary sweet. The groom pays little attention to his bride during the reception because he is responsible for making their many guests happy.

The first few weeks or months of marriage, depending upon when the next harvest season occurs, the young couple eat with his family. She becomes fully responsible when he harvests the first crop. She helps her mother-in-law in the garden, after a three day rest period following the wedding.

Family Life

The man has sole authority in the household, the wife respects and obeys her husband. The relationship between the couple may be very affectionate and beautiful though very different from the Western way of exhibiting affection.

The first child is born in the home at the end of the first year or during the second year of marriage. If not, the woman will start to seek outside help either from the local witch doctor or from a medical clinic. Some will come for examination and advice if regular menstrual periods have continued six months past their marriage.

The sex of the first child is of little importance and if the husband is asked about it, he may not even know it for several days. In general, they like the children to be equally divided and they prefer a girl among the older children, in order that the mother will have a helper at home to care for the younger child, to gather firewood, to carry water, and to help with the meal preparation.

Upon giving birth, the mother is confined to her house and yard

for one week. Before she is to appear in public, the husband gives a "coming-out-party" for her and the baby. He invites close friends to come and share in their joy. The baby's head is shaved and in the older customs the mother's head was also shaved, but it may not be now. This practice seems to have no superstitious significance. At this party the baby's name is announced.

The child may be named a very degrading name to protect him from the evil spirits. Many believe if the name signifies that the child is of little importance, the evil spirits will not bring death to him. Examples of this type of name are: 'That monkey', 'Little pig,' 'Goat manure,' or 'The mole.' Another type of name which may be given to him would relate to an event which happened at the time of his birth; this often has a tone of bitterness to it. Examples are: 'I am in the place of hate,' 'I am loved by few,' 'They deceive,' and many similar phases expressing a feeling of the mother. Since Christian teachings have been introduced, they often incorporate God in the name, as in: 'I pray to God,' 'I wait for God,' 'Although God,' 'I continually trust God'. Among the Christians, the name of the father may be retained and then only a first name is given the child. Ordinarily a first name is not given a person unless he enters the church.

With each birth the father is to buy his wife a new outfit for her wardrobe. If this is not done the wife has a legitimate complaint

against him. It may be used as evidence if she wants a divorce.

The children are legally the father's unless he obtained his bride without paying the dowry. In that case, they are the children of her parents. If separation occurs, the wife is allowed to take the nursing child with her. The father's family cares for the other children until he remarries.

Divorce and Polygamy

Divorce rates are lower than in Western cultures. The husband may reject his wife on the grounds of infertility, laziness, or neglect of the children. The wife seldom leaves the husband because if she does her father must repay her dowry.

Plural marriages are not as common in Burundi as in many other parts of Africa because of land shortage to support a second wife and her children. Under Belgian colonial rules, polygamy was discouraged by taxing a second wife. This custom is still followed.

Previous to 1950, premarital or extra-marital relations with an unmarried girl were uncommon. The tribal punishment of the girl was very severe. She was rejected by her family and friends and put in a place of great shame. The practices often led to the death of the girl during labor. In Rwanda, on Lake Kivu, there was a tiny swampy island where the girls were placed to die. Urbanization has affected change in these customs and now the illegitimacy

rate is increasing, but not at the rate of Western cultures.

Weaning and Eating Habits

The Murundi woman breast-feeds her infant at least two years or until she becomes pregnant. The custom of carrying the baby on her back in a goat skin gives him security, warmth, and immediate relief from hunger and thirst since the mother feeds him on demand. At night the baby sleeps beside the mother, nursing frequently. The mother usually has sufficient breast milk for her child until he is six months old, at which time he commences to lose his chubbiness and becomes lean.

Marasmus is seen in orphans or in babies of mothers with insufficient breast milk. Seldom does a mother not have enough breast milk for her child, an exception is if the mother has a severe illness. When this does occur, it is very difficult to convince her that she does not have sufficient milk to feed the child. The mother is very reluctant to supplement her breast feedings with formula.

Solid foods are started at 10 to 12 months after a sufficient number of incising teeth are cut. The mother feeds him food from her plate. His first foods are usually beans, cooking bananas, and sweet potatoes. He receives diluted banana beer to drink. Between meals, feedings are pieces of sweet potato, poached corn, or raw manioc. He plays in the backyard while eating his food, and consumes

dirt with the food. Diarrhea and vomiting often occur as a result.

The child may also be infested with one or more intestinal parasites after six months of age. The most common parasites are ascaris lumbricoides and ancylostoma duodenale. If the child has an early and severe infestation of parasites, he will manifest marked symptoms of malnutrition by one year of age.

From six months to three years of age is a very precarious period for the child. Undernutrition makes him prone to infectious diseases (124). If he does not die during the infection, he is left with his body weakened and without an appetite. Often within a few weeks, he is in a kwashiorkoric state.

The children are unable fully to assimilate their diet until they are from two and one half to three years of age. The beans are indigestible unless the outer cellulose shells are broken. The carbohydrates have high roughage content and unless chewed thoroughly, they are not completely digestible. Unless the mothers prepare special foods for their children, the children will suffer the effects of undernutrition or malnutrition during this period.

The children eat routinely in the kitchen. If the child is fussy and hungry while the mother prepares the meal, she gives him food from the pot which is cooking on the stove. This food may not be fully cooked. The child often does not receive the choice foods: meat, peanuts, rice, bread, and tea; but eats only what is left after his

parents and the guests are finished eating.

The wife usually prepares enough beans for at least two meals to economize on fuel and preparation time. The child is not allowed to take food from the pot between meals without permission from his mother. If he does take food, he is referred to as a child who steals.

The main meal is eaten between 7 and 9 P.M. This meal consists of beans with sweet potatoes, dry peas with bananas, or beans with cassava root. A very special meal is stiff porridge (umutsima, ubugari) made from finely ground corn, cassava, wheat, or millet and added to unsalted boiling water until it is extremely stiff. The Barundi break off small pieces of it and dip it into a salty sauce made from crushed beans with vegetables or meat.

The food left from the night before is eaten the next morning. Only in more educated families does the wife prepare a hot morning meal. Likewise, at mid-day only the elite eat a meal.

Cooking of the food is done in a room of the house or in a small annex in the backyard over three simple stones which have been firmly set into the ground. If the cooking is done in an annex it frees the house from smoke but the warmth from the fire is lost and the house may be cold and damp during the rainy season.

In the more densely populated areas fuel for cooking is scarce, requiring the wife or daughter to go for miles to a wooded area to gather wood for cooking. In urban areas people use charcoal made

from the eucaplytus tree for their cooking. Wood can not be gathered from the planted groves of trees without special purchase permits.

Eucalyptus trees are not native to the country but the German and the Belgians foresaw that the fuel shortage would soon be extremely grave if groves of eucalyptus were not planted. Even with these it is difficult to find adequate firewood in many sections of the country. Groves of cedar trees were also planted for lumber purposes.

Educational System

The schools were started by Catholic and Protestant missions, it was not until in the 1950's that any government schools were opened to African children. Even in 1971, government operated schools are very limited in number. The most of mission schools are financed and strictly controlled by the government.

The school system follows a Belgian curriculum with minor changes. The students start learning French in the first grade and by the fourth or fifth year all their studies are in French. The primary school is through the seventh year, at which time, the students are given a national examination. The Ministry of Education only gives seventh year certificates to enough students to fill the openings in the secondary schools. The other students are not passed. The student is

permitted to repeat the seventh year once and then be reexamined.

The literacy rate for Burundi is eight percent. If the women and girls are considered separately, their literacy rates would be one to two percent.

In the mid-1960's there were 100,000 pupils in primary school which made a ratio of 1 to 15 among children under 15 years of age who attended school. In 1970 many small rural schools were closed, where there were less than three classes in the school. In the mid-1960's there were 3,000 students in secondary schools, making a ratio of 1 to 500 who have an opportunity for higher education (125).

The primary schools are open to either sex but the students are predominantly male, since many of the parents see no value in educating their daughters, especially the older daughters who are needed at home to help their mothers with the care of the home and the garden.

The secondary education has two cycles. The lower cycle is three years; from there the student may enter professional schools. The better students continue to the superior cycle of secondary schools which prepares them for university entrance. There is only one university in Burundi and it provides two years of education to a very limited number of students.

The secondary schools are not co-educational but special secondary schools are available for girls. The girls usually become the teachers, midwives, or secretaries.

Schools are very strictly controlled by the government and no new private schools may be started without governmental approval. This restriction has limited the mission hospitals from having a medical center for education of their personnel.

There is only a limited number of trade and technical schools. This type of school is not strongly encouraged by the government.

There is a devastating attitude among the men who have had primary school education for they feel they can not soil their hands with manual labor after becoming able to converse in French. Many are content to return home, when they are unable to enter secondary school, and never apply any of their education to improve their living conditions. This attitude prevails among the professional men who hire workmen to do all the manual labor and never help care for their home and gardens during the evening hours and on their free days.

Religion and Superstitions

Deities

The people of Burundi have believed in a Supreme Being the Creator of all things since ancient times. He is called Imana Rurema. This has made them readily accept the teachings of Christianity. The majority of the people in this generation profess Christianity as their religion. The majority adhere to the Roman Catholic faith with a minority who are Protestants. Those of Islam faith are found mainly among traders who have been associated with the Arab population.

The word 'Imana' is also used for any object which is worshipped as a divine power. In the remote areas of Burundi, the people will paint cooking pots, rocks, or trees and pray to them as their 'imana'.

There is one other god they often refer to and worship, 'Kiranga'. In their belief, he is a supernatural power but not the Creator. He is prayed to to keep evil away from their homes and themselves.

Superstitions

The goat or antelope skin in which the baby is carried has the same name as the placenta (ingovyi or insimbizo), this skin is highly protected from damage. If damage occurs to the goat skin it signifies that upon giving birth to the next child, 'kiranga' will bring punishment which will cause the death of either the child or the mother.

For many years the pythons were not killed because they contained the spirit of the deceased kings. The center of a whirlwind consists of the spirit of a python, or, in essence, the spirit of an ancient king.

A pregnant woman must be very careful not to encounter a python. Since pythons commonly inhabit the valleys, this is probably the reason that the men must cut the brush and grass from the valley before the women will enter it to cultivate. One woman related,

after giving birth to a set of premature twins, that she had gone through the valley while pregnant and had come upon a python; this was the cause of her giving birth to premature twins. She did not seek medical care for the twins because this was her punishment for having gone in the valley where she knew pythons lived.

The owl, as in some other African cultures, is a bad omen. If one hoots above the home, it signifies that evil will come upon that house. Whenever an owl is seen near a dwelling, it is immediately chased away.

Multiple births are a sign of an animal spirit and may lead to rejection of the wife if she continues to produce multiple births. According to an old Kirundi custom either one or both twins were killed at birth by a special potion from the witch doctor which produced petechial hemorrhage which caused the death within 12 hours. The mother had to go through a special ritual to take away her uncleanness. A sheep had to be bought and kept among their herd to keep further evil away from her.

Twins are still disliked and often one child will be neglected in order that he will die. There is no set routine of whether it is the older (Bukuru) or the younger (Butoyi) twin who is neglected. Many of those with Christian faith have reared both twins and no evil has come upon them for not following Kirundi custom.

Medical and Black Magic Practices

Types of Illnesses

The Barundi diseases are thought of as three general types: the trivial or every day diseases, the diseases which respond to Western medicines, and the Kirundi diseases which are unlikely to be understood or to respond successfully to scientific medicine (126). The trivial illnesses are the common colds, coughs, infections from insect bites, gastro-intestinal upsets and other minor symptoms which are often not treated. The diseases which respond to Western medicine are those treated with antibiotics, antimalarial drugs, and surgical intervention, such as yaws, tropical ulcers, fevers, hernias, and intestial constructions.

The Kirundi illnesses generally are joint or migratory type pains. Often the sickness is the result of an "evil eye" (amashinge) which has been cast upon them. This type of illness may be psychosomatic in nature and if the patients do come for treatment at a Western clinic, it is very difficult to treat successfully because people feel that they will not become well unless they are treated by the witch doctor. Some of the Kirundi illnesses have definite pathology; an example of this is a purulent synovial infection. Other illnesses which were previously treated with Kirundi medicine are now recognized as syndromes which respond to Western medicine. Kwashiorkor is

among this group. Thirty years ago children were rarely brought for treatment and if they did it was only a few hours before death. After seeing children respond to scientific treatment the barriers were slowly removed. Now, children are often brought for treatment during a subclinical state.

Medicine Man

In the area of Kirundi medicine and black magic, there are two distinct types of personnel, the umurozi or sorcerer and the umupfumu or witch doctor. The umupfumu treats illness but he also possesses magic power.

The umupfumu practice is very different from the sorcerer. He deals with illness and usually uses herbs or animal parts for his treatment. Some of the animal parts he uses for medicine are whiskers, toenails, ears, heart or parts of the entrails. The umupfumu can be of either sex and does not need to dress differently from the average person. Sometimes his hair is longer, with mud-daubed ringlets, and his clothes and body are unwashed.

The medicine men use specific potions usually made from bark, leaves, or roots for the treatment of specific symptoms of diarrhea, vomiting, difficult breathing, ascites, painful joints, and backache. Small cuts known as indasago are made around swellings or over painful areas. These cuts are made either to give the evil spirit an

exit or to provide a place to insert a powdered medicine. These are seen commonly on the temples for the treatment of headache, or on the chest for treatment of pneumonia. Dr. Gelfand, a medical officer and university professor in Rhodesia for many years, in his book Witch Doctor says this treatment increases the blood supply and may prove effective in certain complaints. Most often the healing is credited to the powdered medicine and not to the scarifications (127).

For burns, wounds, and tropical ulcers the medicine man makes a poultice from cow dung which he applies with a leaf and ties with grass bands to hold it in place. On tropical ulcers a yellow powder which smells like iodoform is used frequently.

For snake bites the medicine man has a set of stones which he rolls to decide the type of medicine to use for the particular snake bite. In an area where this practice is common and snake bites are frequent. In an eight year period at a busy clinic no one was treated for snake bites.

The witch doctor is consulted for infertility if the woman is unable to conceive at the expected time. The inability to conceive is nearly always thought to be the fault of the woman. This may be grounds for divorce or, at least, for the man to obtain a second wife.

There are areas in every market place where native medicine and charms may be bought. Charms are worn for protection against sickness and death. They are commonly made from carved pieces of

wood, bone, or horn. The charms may be tiny metal bells or hooks. The young girls and women may wear many strands of small pink beads around their hips to insure fertility.

Africa is unlike some other areas of the world where the witch doctor prohibits their patients from using Western medical facilities. The Africans feel free to treat themselves and their children where they like or they may use both types of medicine simultaneously.

The patient who has not improved will leave the hospital at night without permission, to obtain help from a witch doctor. This may be in the middle of a treatment in which, if he would have stayed a few more days, he would have been well.

Sorcerer

The umurozi can be of either sex though women seem to predominate. Their dress is usually very ordinary, though the women will wear a beaded head band and carry a spear. The head band is commonly worn by many people on a festival day but carrying of spears under ordinary circumstances is reserved for the men. Wearing a head band and carrying the spear designate a woman as a umurozi. People who seek her service usually want revenge. The person who seeks revenge will go to the sorcerer and have a "spell" cast on his enemy or he will be given powder to sprinkle in his enemy's house or to put into the food of the enemy. This powder may

poison which will kill the family immediately upon ingestion. The powder may not in itself be poison but derives its potency from the great fear it induces when the persons for whom it is intended learns of the spell. Those who have had "spells" cast upon them will stop eating and often die weeks later without any medical reason.

Another type of service the umurozi performs is to give medicine, such as a love potion, to make a mate again love his partner. This practice is more common among the women, especially if the husband spends many evenings away from home. The wife obtains a fine powder to sprinkle in the house and in his bed so his love may return. If this does not work she returns to the umurozi to get more medicine to cook into his food. This same type of practice is found among the unmarried. If a girl wants a certain young man to marry her, she obtains this magic love powder to place in food. She then prepares a special meal and invites him to attend, after partaking of the especially treated food, she wins his heart and a few months later becomes his bride.

Another magic medicine known to the Barundi is one to prevent stealing or to make the thief return the stolen goods. For instance, if a man steals a basket of corn and the owner immediately goes to the umurozi, he uses his magic power to find the thief. The umurozi puts a hex upon the thief and when the thief arrives home he is unable to remove the basket from his head. He calls for his kin to help him out

but they also are not able to pull the basket from his head. The only thing left to do is to return the basket of corn to the owner.

Another type of black magic often used for revenge against chauffeurs is sprinkling a magic powder across the road where the avenger knows the truck will soon be passing. When the chauffeur arrives at this place he loses control of his truck and has an accident.

These practices sound odd to the Westerner's ear, but the average Murundi still uses the umurozi or, if he no longer uses his services, still fears the power he possesses. If a spell has been cast on him, the only way he knows to be freed from it, is to go to an umurozi to have the power broken.

Summary

Located in the heart of Africa, in the mountainous region of the Congo-Nile divide, is the small postage-stamp country of Burundi. The densely populated independent state has three ethnic groups of people: the Batutsi, the Bahutu, and the Batwa.

Burundi has two seasons. The dry season from May through September. The wet season starts with light rains in October and the rains become severe in March and April.

This agricultural country exports coffee and cotton. It also produces beans, sweet potatoes, bananas and cassava for its staple crops. The long horned cattle are principally used for wealth status

and for dowery; the cows do not produce enough milk to alleviate the nutritional needs.

The houses are constructions of mud and wattle or of sun dried bricks, and are usually thatched with grass or banana bark. The small springs in the valleys are the source of drinking water.

It is a patriarchal society with the sons building their homes near their father. There are close family ties and divorce is infrequent. The women have the responsibility of caring for their homes, children, and gardens.

The schools are principally mission operated and are able to provide primary education for one child out of fifteen and secondary education for only one child out of five hundred. The literacy rate is eight percent for the total population.

The majority of the people in this generation profess Christianity as their religion but witch craft, sorcery, and superstitions are present.

REFERENCES AND NOTES TO CHAPTER III

[108] The chapter was read and authenticated by Randall Brown and Esther Choate; both have spent many years in Burundi, Africa.

[109] Prefixes: The Kirundi language has prefixes which denote the noun class. The prefixes used in this chapter are:

a. umu (singular), aba (plural): used to designate people.
umuntu, abantu--a person, people.
umurundi, abarundi--people of Burundi. The first vowel is usually omitted.
umututsi, abatutsi--the ruling class of people (sometimes seen as watutsi which is Swahili).
umuhutu, abahutu--the middle class people.
umutwa, abatwa--the pygmy class.
umwami, abami--the king.
umuganwa, abaganwa--the Batutsi nobles who were chiefs.
umutware, abatware--the subchiefs, generally Batutsi nobles.
umupfumu, abapfumu--the witch doctor.
umurozi, abarozi--the sorcerer.

b. ubu (singular), ama (plural): used for abstract nouns and as a title prefix of a country--Burundi, Buganda (Uganda).

c. iki (singular), ibi (plural): a prefix denoting things or languages. Kirundi--the language of the Barundi. The word Kirundi is used when referring to a custom of the Barundi people (Kirundi medicine).

[110] Background Notes, Republic of Burundi, U.S. Department of State (February 1969), Washington, D. C.

[111] Ibid.

[112] The Economist Intelligence Unit Quarterly Economic Review, Annual Supplement Congo, Rwanda, Burundi (1970), p. 22.

[113] Ibid., p. 22.

[114] Traveller's Guide to the Belgian Congo and the Ruanda-Urundi, 2nd edition, 1956, Brussels, Belgium. p. 401

[115] Ibid., p. 401.

[116] Background Notes, op. cit.

[117] Background Notes, op. cit.

[118] Background Notes, op. cit.

[119] The Economist Intelligence Unit Quarterly Economic Review, op. cit., p. 22.

[120] Ibid., p. 22.

[121] Ibid., p. 22.

[122] Ibid., p. 22.

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[124] Scrimshaw, N., Interactions of Nutrition and Infection, WHO Monograph Series #57, Geneva, 1968.

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CHAPTER IV

NUTRITIONAL PREVENTION AND REHABILITATION OF KWASHIORKOR IN BURUNDI, AFRICA

Feeding the Infant and Preschool Age Child

There are several causative factors in the development of kwashiorkor in Burundi: parasitic infestations, intercurrent infection, and ignorance of how to wean and properly feed an infant. The purpose of this chapter is to review the necessary requirements for the adequate nutrition of children and to indicate what foods are available in Burundi to meet these requirements.

The World Health Organization recommends prolonged breast feeding for children in the tropics. It is an absolute biological necessity, for without breast milk the infant frequently dies (128). In later lactation, after six months, the breast milk is not sufficient to meet the needs of the child, but it does provide him with a supplement of essential amino acids. This does not imply that supplementary feedings should not be started; they may begin at about six months of age. The supplementary feedings are not started until this age because of the danger of gastro-intestinal infections in areas where sanitation

standards are low (129).

The infants in Burundi are nearly all breast fed until the second year of life. The Murundi mother is an expert breast feeder, considering her diet and her responsibilities. The infant's weight gain is generally good until he is seven to eight months of age, at which time it begins to fall below the normal gain.

The common practice among the Barundi women is to commence the supplementary feedings at 10-12 months of age. They prepare nothing special for their infants but only give them food from their own plate. In regards to infant feedings, there are three changes which should be made: supplementary feedings should be started at six months of age; instruction on the types of suitable foods be given; and instruction in preparing these foods. Some foods are available which are inexpensive, and which would be beneficial for the infant. These include fresh fruits of bananas, payapas, and oranges. Other foods are specially prepared gruels of corn, millet, wheat, and rice. Peanut milk and eggs are also good foods. At seven to eight months of age bean paste could gradually be added to his diet, along with sweet potato, cooked bananas, and cassava root. The addition of these foods provides the child with adequate calories and nutrients during breast feeding and prepares him for weaning. See Tables I to III for a sample diet and the recommended daily requirements of young children.

Weaning is often very abrupt and frequently occurs when the mother discovers that she is pregnant. Prior to weaning the Murundi child is very intimate with his mother. He spends many of his sleeping and wakeful hours riding on his mother's back as she does her daily work, and at night he sleeps next to her. When he is weaned, he is suddenly divorced from this intimacy and dependence. At the same time he has a radical change in diet. His appetite is impaired by the psychological trauma he has suffered. Often he develops diarrhea from his diet change. Instruction of proper weaning is an important aspect in preventing kwashiorkor (130).

The present dietary practices are not satisfactory for the weaned child. Often the diet is insufficient in the quantity and quality of protein. Vegetables and fruits are fed infrequently. The food offered the child is often impalatable for him. Between the two daily meals, only starchy tubers and roots are offered the child, and these are frequently raw.

Recommended alterations for the weaned child and the pre-school age child are: 1. Increasing the protein quality and quantity by: dehulling the beans and peas; adding more peanuts to the diet; encouraging the use of eggs and chickens; and promoting the planting and the use of soy beans. 2. Encouraging the planting and the use of vegetables and fruits in the diet. Teaching the use of leaves of sweet potato, cassava, squash, bean, and eggplant. 3. Teaching the

TABLE I

A Sample Diet for a Six Month Old Infant and His Daily Requirements

Food	Amount	Calories	Protein gm	Calcium mg	Iron mg	Vitamin A U.I.	Thiamin mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
Breast milk	500 ml*	375	5.5	170	--	950	.08	.18	.735	21.5
Gruel Millet--50 gms Sugar--2 teaspoons	200 ml	197	3.7	198	8.5		.09	.05	.4	--
Papaya	100 gm	32	0.4	21	.6	1538	.03	.03	.4	52
Banana	100 gm	88	1.5	9	1.4	200	.03	.03	6.0	9
TOTAL		692	11.8	398	10.5	2733	0.23	0.29	7.54	825
RDA** for a six month infant (6 kg)		600	10.8	600	15	1500	0.5	.6	8	35

*Estimated amount

**Food and Nutrition Board, National Academy of Sciences-National Research Council Recommended Daily Allowances, Revised 1968

TABLE II

A Sample Diet for One Year Old Infant and His Daily Requirements

Food	Amount	Calories	Protein gm	Calcium mg	Iron mg	Vitamin A U.I.	Thiamin mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
Breast Milk	350 ml*	257	3.8	51	--	665	.06	.12	.5	15
Gruel Corn--150 gms Sugar--3 teaspoons	400 ml	583	12.9	9	4.2	50	.54	.12	2.1	7
Sweet Potato	100 gms	121	1.6	33	2.0	125	.09	.04	.7	37
Bean, crushed	cooked 100 gms	141	5.9	46	1.9	3	.07	.03	.4	--
Orange	1 orange	43	0.6	28	0.1	125	.02	.03	.2	46
TOTAL		1145	24.8	167	8.2	968	0.78	0.34	3.9	105
*RDA for one year infant	9 kg	1100	25	700	15	2000	0.6	0.6	8	40

* Food and Nutrition Board, National Academy of Sciences - National Research Council Recommended Daily Allowance, Revised 1968.

TABLE III

A Sample Diet for Three Year Old Child and Daily Requirements

Food	Amount	Calories	Protein gm	Calcium mg	Iron mg	Vitamin A U.I.	Thiamin mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
Beans, cooked Palm oil--1 teas.	100 gms. dried 2 servings	336 44	21.7	120	8.2	16 5000	.37	.16	2.4	--
Greens Sweet Potato Leaves	50 gm	25	5.1	77	3.1	4891	.05	.14	.4	35
Cassava	100 gm	357	1.3	121						
Corn, parched	1 ear	357	8.6	6	2.8	33	.36	.08	1.4	5
Pineapple	200 gm	94	0.8	32	.8	300	.12	.06	.2	68
TOTAL		1169	37.5	356	14.9	10240	0.87	0.44	4.4	108
*RDA for three year old child		1400	30	800	10	2500	0.7	0.8	9	40

* Food and Nutrition Board, National Academy of Sciences - National Research Council Recommended Daily Allowance, Revised 1968.

necessity of specially prepared food for the child. 4. Stressing the need for frequent feedings for the child.

Treatment of Kwashiorkor

One of the measurements of effective treatment of kwashiorkor is the increase of serum albumin. Studies have shown that two grams of milk protein per kilogram of body weight or five to six grams of vegetable proteins per kilogram of body weight will adequately elevate the serum albumin (131, 132, 133, 134).

The mechanism for regulating the concentration of serum albumin is not clearly known. It is thought that low calorie intake and weight loss increase the catabolism of muscle protein and stimulate the adrenal cortex to promote liver synthesis of albumin. High carbohydrate intake increases insulin secretion and favors the transport of available amino acids into the muscle cells where they are incorporated into tissue proteins at the expense of the serum albumin. Diets which produce rapid weight gain and higher nitrogen retention paradoxically can have an unfavorable effect on the serum albumin (135). Waterlow recommended a moderate weight gain in order not to risk overloading the mechanism of synthesis and excretion (136).

The first few days of treatment of kwashiorkor usually consists of a liquid diet since the child has no appetite. It is extremely difficult to feed the child without gavaging him. Milk has been used extensively

during this stage of treatment. Prasanna, et al., have successfully treated kwashiorkor with microatomized vegetable proteins. The serum albumin and weight gain were as satisfactory as children fed with milk formula (137).

The studies of Bowie and Cook (138, 139) revealed a high incidence of lactose intolerance and malabsorption in kwashiorkor children. In light of this, Prasanna (140) noted in his study that in the diets which did not contain milk powder, diarrhea did not persist as long. Milk has been a very effective treatment, but in cases where diarrhea is aggravated by it, another type of treatment should be used.

Madden, et al. (141), in studies of hypoproteinemic dogs found gelatin supplemented with cystine plus tyrosine or trypophan was as potent as beef serum for building new plasma protein. Nine grams of the gelatin mixture would produce one gram of new plasma protein. The formula he used was 70 grams of gelatin, 4.2 grams of cystine, 4.2 grams of tyrosine, and 2.8 grams of trypophan.

Though skim milk has been widely used in the treatment of severe kwashiorkor, it has become increasingly recognized that it is not the practical answer to the problem. In most developing countries a search for suitable vegetable protein foods is being made. Some factors influencing the choice of the food are: the cost, the local availability, the acceptability by the community, and its nutritive

value (142).

The amino acid content of a protein determines the value of the protein rather than the total amount of nitrogen. The simplest method of evaluating protein quality is the biological value (B. V.) index. This measures the relationship of protein retention to protein absorption. The basic assumption of the biological value index is that more nitrogen will be retained if the essential amino acids are present in sufficient quantity to assure growth. A more widely used measure of protein quality is the net protein utilization (NPU), which measures both the digestibility and the biological value of a protein. The array of amino acids in the egg is the nearest to breast milk and has been used as a basis for rating protein. The egg has a net protein utilization of 100 (143).

A protein with a net protein utilization of 60 to 70 is generally used in developing countries, and it may be as low as 50 to 60 where cassava is found in the diet. The net protein utilization and the limiting amino acid are given in the food composition chart in Appendix C for the common protein foods of Burundi.

The net protein utilization may be elevated by giving mixtures of protein foods. For example the limiting amino acids of corn are trypophan and lysine, and for soy the limiting amino acids are the sulfur amino acids; by mixing the two and feeding the two together it is possible to increase the net protein utilization (144).

Of the vegetable proteins raised in Burundi, the net protein utilization ranges from 47 to 66 percent. In order successfully to treat kwashiorkor in the acute stage without the assistance of eggs or skim powder milk, a blend of two or more vegetable proteins would need to be developed.

At the present, considering the cultural and socioeconomic aspects of the people, it is more feasible to recommend feeding the child with kwashiorkor a gruel of millet or corn when he is fed a meal of dehulled beans or ground peanuts than to recommend extensive use of animal proteins. The cost of animal protein is not within the financial means of the average family, though most families could furnish two to three eggs weekly to their preschool age children.

Table IV gives a recommended diet of a child with mild kwashiorkor using foods grown and accepted in Burundi. A child with severe kwashiorkor should be hospitalized or closely observed during the acute phase of the illness and fed supplementary feedings of animal protein.

TABLE IV

A Sample Diet for a Two Year Old Child with Kwashiorkor and His Daily Requirement

Food	Amount	Calories	Protein gm	Calcium mg	Iron mg	Vitamin A I.U.	Thiamin mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
Gruel										
Millet--100 gm	400 cc	329								
Sugar--3 teas.		60	7.4	397	17.1		0.18	0.11	0.8	
Crushed beans	100 grams (dried)	336	21.7	120	8.2	16	0.37	0.16	2.4	
Greens										
Cassava	50 grams	45	3.5	151	3.8		1.2	.30	0.1	
Peanuts, ground	50 grams	297	11.7	21	1.9		.22	.05	7.6	
Pumpkin	50 grams	12	1.0	25	1.4	5608	.05	.02	0.5	8
Egg	one	140	11.8	45	2.6	500			0.3	
Pineapple		47	.4	16	.4	150	.06	.03	0.1	34
TOTAL		1266	5.75	1350	35.4	6274	2.08	0.67	11.8	42
RDA 10 kg child		1250	5-6 gms of vegetable protein/kg	800	15	2000 UI	0.6	0.7	8	40

TABLE V

Composition of Foods of Africa (145, 146)

100 grams of edible product	Calories	Carbohydrates	Fats	Proteins	Protein NPU	Amino Acids per Gram of Total Nitrogen in Edible Portion of Food								Calcium	Phosphorus	Iron	-carotens equivalent	Thiamine	Riboflavin	Niacin	Ascorbic Acid
						Tryp-tophan	Theo-nine	Iso-leucine	Leucine	Lysine	Sulfur amino acids	Aromatic amino acids	Valine								
		gm	gm	gm		mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	ug	mg	mg	mg	mg
Animal Products																					
Eggs	140	0.6	9.6	11.8	100	103	311	415	550	400	342	630	464	45	200	2.6	300*			0.3	
Milk cow's	79	5.4	4.8	3.8	75	90	294	407	626	496	213+	634	438	143	95	-	80**	.044	.175	.094	1.1
human	75	9.1	3.1	1.1	100	103	284	344	567	413	253	595	391	32	18	-	Retinol 190	.016	.036	.147	4.3
Antelope	150	-	2.2	30.4										65	302	2.1					
Beef muscle	122	-	3.8	20.6	80	73	276	327	512	546	234+	469	347	22	141	4.6					
liver	143	5.0	4.7	19.0	65	94	297	327	577	468	224+	549	393	8	360	10.0	180***				
Chicken	146	-	6.5	20.5		76	266	330	452	549	247	266	307	10	206	1.1					
Fish Tilapia	101		1.9	19.7	83	62+	271	317	472	548	266	401	333	112	344	3.2		.03	.05	1.5	49
dried	374		6.4	74.0										2700	2800	11.8					
Mutton	265		21.4	16.9		81	286	324	484	506	232	471	308	10	148	2.0	tr.***				
Pork	418		40.5	12.4	84	81	290	321	460	513	229+	469	325	11	174	1.8					
Grains and Cereals																					
Bread wheat, European type	252	50.5	1.4	7.9		61	189	288	448	151+	229	475	292	21	121	1.6		.04	.02	.9	
cassava, Kirundi type	259	59.1	1.2	3.9										44	46	1.7					
Corn pale variety	357	73.9	4.3	8.6										6	182	2.8	20	.36	.08	1.4	5
yellow variety	364	73.6	4.8	10.0	55	38+	249	289	810	180	197	666	319	13	219	4.9	100	.32	.12	1.7	4
Millet ragimillet	345	72.0	4.5	9.9	56	80	254	374	583	190+	430	247	445								
unspecific	329	77.7	1.3	7.4	56	127	233	325	893	196+	216	259	349	397	244	17.1	tr.	.18	.11	.8	

*Additional 350 ug of Retinol **additional 95 ug of Retinol ***additional 810 ug of retinol ****additional 10 ug of retinol +The limiting amino acid

145 Food Composition Table for Use in Africa, Food and Agriculture Organization of the United Nations Nutrition Division and U. S. Department of Health, Education, and Welfare Public Health Service, Bethesda, Maryland, 1968.

146 2 Orr, M. L., Watt, B. K., Amino Acid Content of Foods, Home Economics Research Report #4, Washington, D. C., 1957. p. 8.

TABLE V Continued.

100 grams of edible product	Calories	Carbohydrates	Fats	Proteins	Protein NPU	Amino Acids per Gram of Total Nitrogen in Edible Portion of Food: Tryptophan	Theonine	Isoleucine	Leucine	Lysine	Sulfur Amino Acids	Aromatic Amino Acids	Valine	Calcium	Phosphorus	Iron	-carotene equivalent	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Grains and Cereals, cont.																					
Rice	363	79.9	.5	7.0	57	64	233	279	513	235+	188	571	416	9	127	1.7		.10	.03	2.8	
Sorghum white	342	74.0	3.2	9.8		70	224	340	1004	170	212	483	357	40	320	5.8	15	.35	.14	3.3	
yellow	353	76.6	3.9	8.7										70	-	5.0					
Wheat soft	330	70.7	1.6	13.9		72	168	253	391	160	217	506	270	54	275	6.5		.32	12	3.6	
Legumes and Nuts																					
Beans dried	336	60.9	1.5	21.7	47	58	271	355	537	464	125+	586	379	120	323	8.2	10	.37	.16	2.4	
(fat added) cooked	141	17.9	5.7	5.9										46	120	1.9					
Lima dried	127	61.1	1.4	21.7		59	296	362	520	416	194	533	392	116	387	4.9		.33	.16	2.1	
Peanuts roasted	595	21.7	50.9	23.2	48	69	168	257	380	223	149+	540	311	42	354	3.8		.45	.11	15.3	
boiled	235	26.3	8.3	16.8										45	260	5.1		.44	.16	1.4	
Peas dried	339	62.0	1.1	22.3	44	66	241	352	517	458	156+	567	350	90	382	17.9	15	.88	.17	3.0	tr.
Soybean dried	405	33.9	17.9	33.7	56	86	246	336	482	395	195+	508	328	183	541	6.1	55	.71	.25	2.0	
Cottonseed cake	369	27.4	7.9	51.1	66	74	221	236	369	268	188+	498	308								
Sesame	558	22.3	48.4	17.9	56	91	194	261	461	160+	311	661	244	816	600	8.1	30	.68	.19	3.4	tr.
Starch roots, tubers and Fruits																					
Bananas cooking	98	22.5	0.1	2.4		55	152	319	338	282	121	281	371	13	66	.8					
Cassava, bitter	149	35.7	0.2	1.2										68	42	1.9	30	.04	.05	.6	31
sweet dried	357	86.6	0.5	1.3		81	172	174	257	258	108+	439	281	121	118						
meal	344	83.2	0.5	1.6		81	172	174	257	258	108+	439	281	66	135	3.6		.06	.05	.9	4
Sweet potato raw	121	28.5	0.2	1.6	72	109	294	301	358	295	216+	629	468	33	38	2.0	75	.09	.04	.7	37
Taro	102	23.8	0.1	1.8		115	294	325	556	363	70	325	375	51	88	1.2	tr.	.10	.03	.8	8
Yams						103				326	100										

TABLE V Continued.

100 grams of edible product	Calories	Carbohydrates	Fats	Proteins	Protein NPU	Amino Acids per Gram of Total Nitrogen in Edible Portion of Food: Tryptophan	Threonine	Isoleucine	Leucine	Lysine	Sulfur Amino Acids	Aromatic Amino Acids	Valine	Calcium	Phosphorus	Iron	-carotene equivalent	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Vegetables (cooked)																					
Beans immature seed	50	5.5	3.2	1.7										42	36	8.0					
Bean leaves raw	36	6.6	0.4	3.6										274	75	9.2	3,240	.18	.06	1.3	110
Cabbage						50	175	180	225	295	183	268	193								
Carrots	40	9.6	0.1	0.9		50	223	240	339	270	207	321	291	35	38	.7	5,480	.04	.04	.6	8
Cassava leaves raw	91	18.3	1.0	7.0										303	119	7.6	1,775	.25	.60	.24	
Eggplant African	40	8.0	1.0	1.4		59	214	318	384	171	33	271	368	13							
leaves	42	6.4	1.0	4.6										391	49						
Leeks raw	46	11.3	.2	1.5										55	50	1.7					11
Onion bulb raw	41	9.6	.1	1.2		92	98	92	165	284	60	380	138	27	45	.8		.02	.04	.2	11
Pumpkin fruit	23	5.5	.1	1.0		82	148	231	328	304	56	250	233	25	32	1.4	3,565	.05	.02	.5	8
leaves	27	4.4	.2	4.0										447	136	.8	3,600		.06	.32	80
Spinach raw	26	5.3	.2	2.1		101	276	290	478	386	230+	467	343	61	46	1.7		.03	.27		46
Sweet potato leaves (raw)	49	4.6	.2	10.2										158	84	6.2	5,870	.1	.28	.9	70
Tomatoes	21	4.8	.2	1.0		54	207	182	255	260	42	268	174	10	24	.6	450	.06	.04	.6	26
Fruits																					
Avocado	121	6.1	11.3	1.4		68				357	58			19	46	1.4	530	.05	.15	2.0	18
Banana ingurube ripe	88	20.6	.1	1.5		95				289	55	162		9	21	1.4	120	.03	.03	6.0	9
amaramasenga ripe	111	25.8	.4	1.2		63				253	23			10	26	.8	285				1
Grapefruit	34	8.6	.1	.8		12				75				21	18	.6	25	.05	.03	.2	44
Guava raw	64	15.7	.4	1.1		60				188	60			24	31	1.3	290	.06	.04	1.3	326
Lemon	29	8.8	.4	.7		25				117	17			25	18	.5			.02		36

TABLE V Continued

100 grams of edible product	Calories	Carbohydrates	Fats	Proteins	Protein NPU	Amino Acids per Gram of Total Nitrogen in Edible Portion of Food								Calcium	Phosphorus	Iron	-carotene equivalent	Thiamine	Riboflavin	Niacin	Ascorbic Acid
						Tryptophan	Theonine	Isoleucine	Leucine	Lysine	Sulfur Amino Acids	Aromatic Amino Acids	Valine								
Fruits, cont.																					
Mango ripe	60	15.8	.2	.6		125				831	71			24	22	1.2	3,200	.03	.05	.4	42
Monkey-ball raw	72	17.1	.6	1.6										28	42	.7		.11	.17	1.9	18
Orange (tangerine)	49	12.3	.3	.8										38	17	1.1	230	.08	.05	.2	28
Orange	43	10.5	.4	.6		39				221	33			28	17	.1	75	.02	.03	.2	46
Palm-nut pulp (raw)	540	12.5	58.4	1.9										82	47	4.5	42,420* 168,800	.2	.1	1.4	12
Papaya	32	8.3	.1	.4		125				400	25			21	15	.6	950	.03	.03	.4	52
Pineapple	47	12.4	.1	.4		78				144	22			16	14	.4	90	.06	.03	.1	34
Strawberry	37	8.9	.8	.3										18	18	.7	80			1.9	53
Sugar cane steam	62	16.5	.1	.6										8	6	1.4		.02	.01	.1	3
Tree Tomato fruit (raw)	57	14.5	.2	1.5										71	30	.7					
Miscellaneous																					
Honey	311	80.1	-	.4										11	4	.6					
Oils and Fats																					
Butter	685		77.3														545 640 (Retinol)				
Ghee	862	.6	97.8													.4					
Palm Oil	875	.3	98.9											6	7		37,300* 128,700	.01	.02		

*Value varies with color--the deeper the color, the higher the value.

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CHAPTER V

THE TEACHING CURRICULUM

Introduction

After the consideration of the different aspects of kwashiorkor in Africa and the socioeconomic, cultural, educational aspects of Burundi, an acculturated curriculum with visual aids was developed to provide health education for the people of Burundi. The lesson plans are simple enough to be used by African health workers who have a minimal education. The content is acculturated to the everyday life of the average Murundi man, woman, and child. The teaching methods used are familiar scenes, concepts, or African proverbs. The visual aids were designed to be simple scenes which are familiar to the audience. They depict living standards of the average Murundi. Effort was made to avoid implying that money is necessary to improve their diets and living conditions, since many improvements may be made with better use of present materials and time. The puppets are similar in facial expression to the Barundi people and as real to life as possible to avoid creating excessive laughter during the lessons.

The playlets are common African scenes which depict a neglectful parent and a parent who is making good use of his physical means. The lessons are short and designed to hold attention, since they will be used in open-air meetings which have many distractions.

Lesson Plans

The entire curriculum consists of five units; each unit has a varied number of lessons. The lesson content is not entirely nutrition-oriented since there is definite interaction between infection, nutrition and general hygienic practices.

Unit I was developed and written in colloquial language for ease of translation. The syntax is different from English syntax since it was written in African context. Some of the terminology is vague in English but is clarified upon translation.

The visual tools (see Appendix B) were designed to clarify the lesson content and to hold the attention of the learners. The posters were simple scenes of oil painted felt, glued to muslin background. The puppets' heads were made of papier-mache to enable molding of the facial features. The puppets were used with the aid of a screen to hide the speaker. The real life experiences were used as demonstrations to show good and poor techniques. The playlets used a narrator to introduce the scene and to give a summary of the lesson.

The lessons were designed for ten to fifteen minutes of

instruction time, giving only two to three major points of instruction. The material is summarized and reviewed to aid the learners to remember the important points of the lessons.

TABLE OF CONTENTS

UNIT V. HOME LIFE

Lesson I. Caring for the House
  Part A. Your Kitchen
  Part B. The Care of the Floors and the Beds
  Part C. Freeing the House and the Body from Insects
Lesson II. Who Cares for the Children While You Garden?
Lesson III. Your Rugo

UNIT I. NUTRITIONAL NEEDS OF YOUR CHILD

Lesson I. Foods for Building Blocks

Purpose of this lesson is to assist the people of Burundi to acquire knowledge

1. of foods which promote growth,
2. of foods which are available,
3. of the proper preparation of foods to assure palatability for the young child.

Visual Aids: Food Chart (see Appendix B).

Lesson:

Do all your fingers have the same name? Of course not. What are the names of each of your fingers? (Starting with the smallest finger, ask the individual finger names.) Do all your fingers have the same function? No. Today we will liken the fingers to different types of foods which should be eaten each day. Would you like to eat just one kind of food all the time? If all you had to eat day after day were sweet potatoes, soon you would not want to eat sweet potatoes. We need to have different kinds of foods to eat. Some foods have the same function, even though they are different foods. Today we will learn about one very important food family. This family is the one to help build and maintain the body. We will call them the building foods or the building bricks. As a builder uses bricks to build a house, the body uses these foods to build itself. Children must eat foods which

have these building blocks because their bodies are growing.

Here on the hand, which two fingers are used the most? Yes, the forefinger and the thumb. These are the fingers which are used to sew or pick up tiny things; without them the hand is not very useful. Because this family of foods is so very important, it is given the value of two fingers so you would remember to eat some of them at least twice a day. Some of these foods come from animals and some of them are foods which you can grow in your gardens. The foods from animals are often very expensive, and most of you could not eat them every day, but some of you could eat them more often than you do or give a little to your children several times each week.

Can anyone think of some foods which come from animals? (As the foods are named, place the felt picture of the food in front of the thumb.) Then there are other foods which may be substituted for these which you can grow. These foods from your gardens help build the body also, and they may be used in place of the ones which come from animals. Although the animal foods are easier for small children to eat and they are better building bricks than the vegetable ones, the legumes may be used instead of the animals foods when they are not available.

First, we will show you one legume which you eat nearly every day. (Place the picture of the beans in front of the forefinger.) Can you think of some other foods which are like beans? (peas, soy, and

intēnge) Peanuts are among these, and they are especially good food for children. Nearly all children like peanuts very much. They are easier to digest than beans for small children. But there is one warning about peanuts: children may choke on peanuts unless they are ground. You should never feed small children whole peanuts but always grind them. For very young children, peanut milk may be made. A child six to eight months may drink peanut milk. Another food which belongs to this family is millet. How do you think you can use millet in feeding your children? Yes, you can make bread out of it, or else you can make a gruel. If the millet has been cooked thoroughly, a child six months old may start drinking gruel.

While we are talking about children, let us say a word about beans also. The whole bean is not usable for a small child. Do small children chew their food well? No, often they swallow the beans whole. Beans with the outer shells on them cannot be used by the body. They pass through the intestine without being used, and as they pass, they produce gas. This produces abdominal pain. Soon, the child will not eat beans because he knows that they make him feel badly. With beans and peas, you must use a fork and mash them before you give them to your child. This does not take very much effort, and it may prevent your child from developing kwashiorkor.

Remember, these two fingers have to work often. They are very useful fingers and without them the hand cannot function

adequately. Without these kinds of foods your child cannot build a good body. Your child needs these kinds of foods often because he is growing rapidly. These foods are necessary for him to have a strong body and to prevent kwashiorkor.

Summary:

1. The forefinger and thumb represent foods from animals and vegetables which build and maintain the body.
2. Children are growing rapidly and they must eat of these foods at least two times each day.
3. When children are fed beans, peas, and peanuts, they must be specially prepared in order to be usable to their bodies.

Lesson II. Foods for Protecting the Body

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of foods:

1. necessary for preventing illness.
2. to develop understanding of the value of fruits and vegetables as necessary components in a balanced diet.

Visual Aids: Food Chart; orange or pineapple and equipment to juice it; a banana or a guava and a fork to mash it.

Review: The foods for building and maintaining the body.

Lesson:

Today, the lesson is about the middle finger. What was its name? (Wait for response.) Yes, the greatest finger of all. If you cut the forefinger, which finger do you use with the thumb? Yes, it is the middle finger. It is a very useful finger. This finger represents foods to protect the body from sickness. The things which protect the body really help to build the body because a sick body cannot grow adequately.

There are really two families of foods in this group--fruits and vegetables. Would you first name some fruits? (As they name the fruits, put their pictures in front of the middle finger.) Most of these are seasonal, except for pineapples, bananas, and papaya; these are available most of the year. Among these three, papaya is especially a very good food for children; even very small children six to eight

months old may eat papaya which has been mashed carefully with a fork. Bananas, also, may be fed small children. The juice from pineapple which has been diluted half with boiled water may be fed to infants, but the pieces of pineapple should not be given to children until they are a year old.

Oranges and guavas are good fruits, but they are only available once a year. The juice from oranges may be given infants. Guavas have a tough skin and bad seeds for very young children, but the pulp may be removed and mashed finely and given to an infant. (Demonstrate how to juice an orange or a pineapple, then add equal amount of boiled water before giving it to a six-month-old child. Demonstrate how to mash a banana, papaya, or guava.)

Now, the second family of foods are the vegetables. There are many in this group. Can you think of some? (Place the figures on the board as they are named.) Most of these are either fried or cooked with the beans, but carrots are good raw. Children three to four years old like to chew raw foods. One caution about raw foods: they must be washed well so the children do not ingest eggs of intestinal parasites.

Among these vegetables, there are several which are very good for small babies--squash, carrots, and greens. After the vegetables are cooked, they are mashed with a fork like we did the fruit before giving them to the child. If the consistency is too stiff, a little juice

from the beans should be added.

These foods keep the body well and help the child to grow well. They keep the child from having colds and keep cuts and bites from becoming infected. They help the child to see well in the dark and keep his eyes well. They are very useful foods for the body. Every day the body needs at least two vegetables and one fruit. You probably think that this is impossible, but if you would plant some fruit trees in your yard, plant more vegetables in the garden, and use leaves from your cassava, sweet potato vines, beans, and squash for greens, it would not be impossible.

This finger is very important because it protects the body and helps the forefinger and thumb to build and maintain a strong body. Let us work very hard at providing vegetables and fruits for our children.

Summary:

1. The middle finger represents fruits and vegetables which protect the body against illness.
2. Children six months old should start eating these foods, but they need special preparation before the child may eat them.
3. Fruit trees should be planted in yards and more vegetables planted and leaves used.

Lesson III. Energy Foods

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of the proper use of carbohydrates in their diet.

Visual Aids: Food Chart

Review: The first three fingers of food chart.

The finger to study today is the ring finger. This finger is not as useful as the other fingers. A hand with only the ring finger would have a hard time using a hoe! The family of foods today are foods which are used every day. But no one can live on these foods without eating other foods. They are the foods to mix with beans or peas. Can you name some? (Place the sweet potatoes, cooking bananas, cassava, etc. in front of the ring finger.)

These foods are called energy foods because they are needed when a person works hard and uses strength, but if a person sits in the yard all day or works in an office he does not use very much energy. That person, if he eats a lot of energy food, becomes fat. You women who hoe, carry water, and gather wood, need energy. It is these foods which provide energy. Children who play and run need energy, but these foods cannot be used to replace beans, vegetables, or fruits. Children, even more than adults, become sick if they eat only energy foods. These foods used alone without beans or peanuts cause the children to have kwashiorkor. Have you ever seen a child

with kwashiorkor who ate beans two or three times a day? No, the child with kwashiorkor sits on a mat all day and eats a sweet potato, roasted corn, or roasted banana. It is extremely important to give a child food for growth and protection before you give him energy food. After he has eaten those foods, then you may give him the energy foods. The energy foods are harmful for the children when they do not eat the other foods first.

Summary:

1. The ring finger represents foods used for energy. They are needed for people who do a lot of work.
2. These foods cannot help the body grow. They must not be given children alone.

Lesson IV. Palm Oil Is a Food

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of the value and the use of palm oil in their diet.

Visual Aids: Food Chart

Playlet:

Scene: In a kitchen where a friend is visiting this poor Murundi home. Ngerageza is busy cutting greens and preparing to fry them.

Characters: Ngerageza (I am trying)--a Murundi farmer's wife with five children. Her husband does not have any outside work but helps with the farming. Ngowe (I am bad off)--A Murundi farmer's wife who is very poor because her husband never helps her with the work.

Ngowe: Mwidiwe (the afternoon greeting), oh, you are cooking.

Ngeregeza: Mwidiwe, yes, I am cooking; with a working husband and five children to cook for it keeps me busy.

Ngowe: I usually work in the garden until it is time to put the bean pot on the stove. We do not eat until about 8:30.

Ngeregeza: How do you keep the children awake until then?

Ngowe: I do not try; they usually roast themselves a sweet potato or some corn and go to sleep before we eat.

Ngeregeza: But your children need more to eat than what they roast in the coals! Children who do not eat beans never grow strong.

Ngowe: What are you going to fry?

Ngeregeza: These are leaves from cassava bush. Have you never used them?

Ngowe: No, I have heard that the Congelese eat them, but I did not think those leaves were really food.

Ngeregeza: Yes, they give a good flavor to the beans and they have things good for the children in them so they will grow well. At least, that is what they tell me in our sewing class. Since I have been frying more greens, the children do see better and so do I. I am not nearly so blind in my kitchen.

Ngowe: Really, I thought that those people did not know anything. And besides, how do you find money to buy palm oil?

Ngeregeza: Well, I really did think that it would be impossible to have oil for frying greens, but I decided to grow a few rows extra of everything in order to have some to sell. I save the money from those things and use it to buy the oil. It does not really take that much oil. I have learned that I do not need to make the greens swim in oil. I use just enough oil to keep them from burning, and it is sufficient to give a good flavor to the beans.

Ngowe: You have encouraged me, especially when I see how

healthy your children look, and my, they have really grown since I last saw them.

I do wish my husband would help me like yours helps you, but that does not give me an excuse for being lazy. I will do what I can.

Ngeregeza: Do you know, since I have been taking more interest in cooking, keeping the house clean and the yard swept, my husband has been more helpful. He even helps cut the wood now, and he hoes in the garden often. He wants to see what new things we can grow. We have just received some new seeds which we planted.

Ngowe: Are you going to let me try some if they grow?

Ngeregeza: Of course, if you like them we will give you seeds after they have multiplied.

Ngowe: I must go carry water now. Do come and see me. Maybe you can give me some more pointers.

Ngeregeza: Let me take this from the stove, so I can walk with you.

Narrator: We have been studying the food families for the past several weeks. Can anyone give the names of all the fingers up to today? Today's finger is this little one; its name is "fats." In this playlet, it told how Ngeregeza was able to obtain and use fats to fry

greens. We learned that it helped her and her children to see in the dark better. This is true about palm oil. This is not true about all fats and oil, but palm oil, like squash and carrots, helps the eyes to adapt to the darkness.

Another thing we learned was how to fry the greens without using too much oil. It is better to have a little oil every day rather than to eat a lot and not have it again for a week.

Lesson V. Better to Rear than to Deliver

Purpose of this lesson is to assist the people of Burundi to acquire knowledge:

1. of the necessity of breast feeding in a tropical country,
2. of the foods and their preparation for a six-month-old infant.

Puppet Speaking:

Bapfasoni (a title of respect for women), today I want you to think about your children which you have had. Some of you have had many children, but you have only a few small ones left. Where are those children? Yes, this one died when he was a small baby, the other one because of diarrhea and vomiting, and the third one died after having the measles. He stopped eating, his hair became light, and his face and feet became swollen. Are these daughters helping you hoe, gather wood, and carry water? Are these sons bringing daughters-in-law home for you? No, the hours you spent feeding and caring for those children have not brought you reward. What value is it to deliver and not to rear? It is good to deliver but even better to care for them so they will grow up to be big and strong.

Are babies born with teeth? Are they able to sit up or walk? Of course not; we all know that!! Their stomachs are not the same as yours and mine. They need special food for a few years. The best food is breast milk. Some of you think that cow's milk or powdered

milk is more sophisticated than breast feeding. Now, even though I am an old lady, listen to my wisdom: how many orphans have you seen fat and healthy? The Ba Misigaro (name for orphans) are few in the village. Those who had milk to drink died along with those who had little or no milk. Breast milk is made for babies; cow's milk is made for calves. When babies drink cow's milk, the milk needs to be altered to be suitable for babies. It is very good to use if you do not have breast milk, but even then it must be used correctly. Cow's milk which is put in dirty bottles makes the child have diarrhea (show a dirty bottle and a clean bottle). For a very small baby, milk given without any water produces vomiting. One must be taught to know how to feed a child without breast milk. (Demonstrate the technique for mixing milk for a tiny baby and for a six-month-old child.) Mixing too much water with the milk is not good. One must know the correct amount of water to be added.

When your child is six months old, you usually do not have enough breast milk for him, and some special foods need to be added. When your child stops gaining weight, it is already past time to start feeding your child other foods beside your breast milk. But remember, if your child is sick or not eating well, take him to the doctor.

Now, the baby may eat boiled eggs, ripe bananas, papayas, orange juice, and well-cooked corn gruel. Do not start all of these at once but only one at a time. Give him one for several days to see

if he develops diarrhea. If he does have diarrhea, stop the food and wait until he is well. Try another one; if it makes him vomit, his stomach is not ready for it. Wait a few weeks and try again. Try just a small amount at the start and then increase it gradually. If he eats one of these special foods, add another one until he eats several of them. You should try to find him at least two or three eggs each week. Of course, you know how to boil them for five minutes, then peel them and mash the egg with a fork until it is in very small pieces.

When the baby is one year old, he should weigh three times as much as he did at birth (use weight chart to explain this).

Remember, to rear the child is more important than to deliver it and let it die.

Summary:

1. To rear a child he must be breast fed.
2. To start solid foods at six months of age makes a strong child.
3. Foods to be started early are papaya, bananas, orange juice, eggs, and gruel.

Lesson VI. Bridging Between Nursing and Solid Foods

Purpose of this lesson is to assist the people of Burundi to acquire knowledge that a child requires foods which are specially prepared for him in order to promote proper growth.

Visual Aid: Poster of Nutritional Bridge.

Review: The foods which a child may eat at the age of six month.

Lesson:

Most of you start feeding your child food from the table at 10-12 months; as soon as he has several teeth, isn't that right? Let me ask you a question: Does your child have all his teeth by that age? Of course not, he has only about eight teeth. These teeth are biting teeth; they are not his chewing teeth! Have you ever tried chewing up corn with your front teeth? It doesn't work so well. This means that your child is not able to chew up pieces of sweet potatoes or chew the beans; he just swallows large pieces or whole beans. The stomach does not have teeth either; therefore most of the food he eats his body cannot use. Not only can he not use it, but it also makes him have diarrhea.

The time that your child is six months old until he is three years old is a very important time in his life. Many of your children die between these ages. We will compare this time to crossing a river. How many of you have ever crossed rivers which have scared

you? I have. I thought that the water would carry me away. Just as a river may not be safe to cross and rather dangerous, this is a dangerous period for your children to cross. But just as the men build a railing on the bridge to help to cross safely, we must help our children to live and be healthy during this dangerous period.

How can we help them? First, we need to prepare food specially for them. Fix beans without the outer skin; cook him peas now and then; give him ground peanuts in his food; mash up the sweet potatoes and other things for him; give him bananas which are very ripe; give him oranges when they are available; find him two or three eggs each week; give him cooked vegetables, and make him some millet or corn gruel to drink. These are a few things you can do to help him cross this bridge.

A child's stomach is not as large as ours, and he needs to eat more often than we do. He needs to eat small amounts about five times each day. This is better than eating a large amount two or three times a day.

Remember to do these things, and it will help him cross the bridge without falling into the river. On the other side he will be a strong healthy child.

Summary:

1. Prepare food specially for him.
2. Do not give him pieces of food, but mash them up.
3. Give him food to build his body--beans, peas,

peanuts, and eggs.

4. Give him foods to protect his body from sickness--vegetables and fruits.

5. Feed him often.

UNIT II. PREVENTING ILLNESS

Lesson I. The Rugo (the working area in the yard where the children play)

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of how to prevent illnesses by making the child's play area:

1. safer against physical injury.
2. freer from parasitic infestation.
3. freer from sources of intestinal infections.

Essential Content	Method of Instruction
1. Method of dish washing a. clean soapy water b. use of a drying rack	Demonstrating a homemade rack Picture of a well-kept rugo and a poorly-kept rugo
2. Routine sweeping of the yard	
3. Preparing a play area for the young child	
4. Preventing injury from a. fire b. sharp tools c. tin cans and broken bottles	
5. Teaching the children to use the privee.	

Lesson II. Bathing the Children

Purpose of this lesson is to develop an understanding of cleanliness and its role in the prevention of disease.

Essential Content	Method of Instruction
1. Reasons for bathing	Playlet
2. Environmental factors	Scene: In the kitchen with a pan of warm water preparing to bathe the baby
3. Technique	Characters: Nsengayumva, a Murundi woman with a two-month old baby. Nkundwa, a Murundi woman who has lost two children with pneumonia.

Lesson III. Intestinal Parasites--where do they come from?

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. mode of transmission of parasites
2. prevention of parasitic infestations
3. treatment of parasitic infestations.

Part A. Roundworms

Essential Content	Method of Instruction
1. The parasitic cycle	1. Picture of a child eating unclean raw cassava
2. The importance of treatment	2. Picture of a child using the banana grove for a privee
3. Methods of prevention a. frequent hand washing b. washing raw fruits and vegetables c. use of a privee	3. Picture of a woman digging cassava root near the banana grove 4. Picture of a microscope

	5. Picture of a privee
Part B. Hookworms	
1. The parasitic cycle	1. Picture of a child eating dirt
2. The importance of treatment	2. Picture of a child using the banana grove for a privee
3. Methods of prevention a. use of a privee b. wearing shoes c. clean play area for children	3. Picture of a woman hoeing in the garden 4. Picture of a microscope 5. Picture of a privee
Part C. Tapeworms	
1. The parasitic cycle	1. Picture of a child using the banana grove for a privee
2. The importance of treatment	2. Picture of a cow grazing
3. Methods of prevention a. preparation of meat b. use of a privee	3. Picture of the men and children roasting meat

UNIT III. INFECTIOUS DISEASES

Lesson I. Your Child Has Measles

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the care of a child with measles
2. the prevention of measles.

Essential Content	Method of Instruction
1. The symptoms of measles	Puppet--depicting an elderly lady with wisdom
2. The treatment and nursing care	
3. The prevention of measles a. spreading them by contact b. the use of vaccine	

Lesson II. Does Your Child Need to have Whooping Cough?

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the care of a child with whooping cough,
2. the prevention of whooping cough.

1. The care of a child with whooping cough a. small frequent feeding b. avoid exposure c. medication for cough	Puppet--depicting an elderly lady with wisdom
2. The prevention of whooping cough a. avoid contact b. immunization	

Lesson III. Why Have Your Child Vaccinated?

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the importance of smallpox vaccinations,

2. the care of a smallpox vaccination.

Essential Content	Method of Instruction
1. Method of preventing smallpox	Playlet: two Barundi women with small children. One has had her child vaccinated and she encourages the other to take her child to have a vaccination. She shows her, her child's vaccination and shows her how she cared for it.
2. The care of a smallpox vaccination a. prevention of multiple foci b. avoid scratching c. prevent flies	

Lesson IV. How to Care for a Child with Diarrhea

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the common causes of diarrhea,

2. the care of a child with diarrhea,

3. the signs of dehydration

Essential Content	Method of Instruction
1. the simple etiologies of diarrhea a. role of flies b. leftover food c. contaminated water d. intestinal parasites	Puppet--depicting an elderly lady with wisdom
2. The care of a child with diarrhea a. foods to avoid b. importance of adequate fluid intake c. early treatment	
3. The signs of an acutely ill child.	Picture of a severely dehydrated child

Lesson V. Tetanus and Your Child

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the cause of tetanus,
2. the care of tetanus,
3. the prevention of tetanus.

Essential Content	Method of Instruction
1. How tetanus is contracted a. deep wounds contaminated with dirt--nails, cuts, with hoes, bottles and tin cans b. care of the cord of a newborn	Puppet--depicting an elderly lady with wisdom Picture of a cut foot as the result of a broken bottle
2. The care of tetanus a. need of medication and hospitalization b. adequate food and fluids c. dark quiet room	
3. The prevention of tetanus a. immunization b. antitetanus serum c. proper disposal of tin cans, broken bottles, and bent nails	

Lesson VI. Animal Bites

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the care of animal bites,

2. the necessity of antirabique serum,

3. the care of a rabid animal.

Essential Content	Method of Instruction
1. The care of animal bites	Playlet: two Barundi men and a child who has been bitten by an animal
2. The type of bite which must be treated with antirabique serum	
3. The care of a suspected rabid animal a. locking it up b. sending the head to the veterinarian	

UNIT IV. CARING FOR YOUR HEALTH

Lesson I. Caring for Cuts and Sores

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the care of cuts and insect bites,

2. the role of flies in spreading infection,

3. the preparation of bandages.

Essential Content	Method of Instruction
1. The care of cuts and insect bites a. washing and disinfecting b. covering of the wound	Playlet--two Barundi women and a child with a cut finger. One woman shows the other how to care for her child.
2. How to prepare a bandage a. type of material b. sterilizing it	Picture of flies on a tropical ulcer. (Use in the summary.)
3. How flies spread infection	

Lesson II. Care of Infected Eyes

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of the care of eye infections.

Essential Content	Method of Instruction
1. The care of the eyes a. effect of dust b. washing the eyes c. flies on the eye d. early treatment	Picture of flies crawling on the eye of a baby

Lesson III. Fevers and Their Care

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the etiologies of common fevers,

2. the care of a child with a fever.

Essential Content	Method of Instruction
1. The common causes of fever a. malaria b. respiratory infection c. ear infections	Playlet: Two Barundi women; one has a small child with a fever.
2. The care of a child with a fever a. extra fluids b. tepid sponges c. when to take him to the clinic	

Lesson IV. The Child Who Stops Eating

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the normal growth and appetite patterns of a child,
2. methods of feeding a child.

Essential Content	Method of Instruction
1. The normal growth pattern	Puppet--depicting an elderly lady with wisdom
2. Normal change in appetites	
3. Reasons for abnormal appetites a. intestinal parasites b. after an acute illness	
4. Methods of assisting a child to eat	

Lesson V. Why Wait Until the Hair Is Blond?

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of:

1. the early symptoms of malnutrition,
2. the importance of early treatment.

1. The early symptoms
   a. poor weight gain
   b. loss of appetite
   c. blondness of hair over the temples
   d. fatty appearance of cheeks and feet
2. The importance of early treatment
   a. to avoid kwashiorkor
   b. to avoid mental retardation.

Puppets: 1. the elderly lady who depicts wisdom
2. a lady with a two-year old child with early symptoms of malnutrition
3. a child with kwashiorkor

UNIT V. HOME LIFE

Lesson I. Caring for the House

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of making their homes safer places to live.

Part A. Your Kitchen

Essential Content	Method of Instruction
1. Improvements a. how and where to store the wood b. a storage shelf c. a board for chopping greens	Playlet: two Barundi women in the kitchen of one of the ladies where improvements have been made
2. Knives and their care	
3. Food storage	

Part B: The Care of the Floors and the Beds

Essential Content	Method of Instruction
1. How to make a good broom	Playlet: a Murundi woman doing her morning's work of care for her house; while she is doing it another woman comes by to greet her and observes the way she is caring for her house.
2. Sweeping and wetting the floors	
3. Care of the beds a. how to make them b. care of bedding	

Part C: Freeing the House and the Body from Insects

Essential Content	Method of Instruction
1. The things which attract flies	Puppet: an elderly man with wisdom
2. Ridding the body and house from fleas and lice	
3. Bedbugs and how to fight them.	

Lesson II. Who Cares for the Children While you Garden?

Purpose of this lesson is to assist the people of Burundi to acquire knowledge of the psychological and physical needs of the toddlers.

1. The feeling of rejection of the weaned child.

2. The physical safety of the child
   a. foreign bodies, cuts, burns

3. The diet of the child while the mother is in the garden

Puppet: an elderly lady who depicts wisdom

Lesson III. Your Rugo

Purpose of this lesson is to assist the people of Burundi to acquire knowledge that a family must work together in order to be healthy.

PLAYLET

Your Rugo

Characters: 1. Mahwa (Thorns), a middle-aged man who has lost several children and has just lost another toddler; he is sitting around a beer pot trying to lose his thoughts.

2. Ndizeye (I trust), an old friend of Mahwa; he was on his way home from work and sees his old friend. He stops to greet him.

Ndizeye: (Greeting his old friend warmly) Have you peace?

Mahwa: Is there any peace when my children die?

Ndizeye: Really, did you lose another child? When was this?

Mahwa: Yesterday, I want to drink my thoughts away. God has cast my home away. This is the third child that has died from that disease which causes swelling.

Ndizeye: It isn't that God doesn't care, but He needs arms to help Him. Your wife needs your help. She can't do all the work by herself and take care of the home and children properly.

Mahwa: I am not complaining about my wife. She works hard and bore many children for me. Is it a man's job to hoe?

Ndizeye: Do you know what causes all this illness?

Mahwa: It is because I haven't bought the right charms for them.

Ndizeye: You do still trust in the things of our grandfathers!!

Mahwa: Not really; I take my children to the doctor also.

Ndizeye: But you listen with one ear only and then go do all the things of our grandfathers.

Mahwa: The charms are only to appease the evil spirits.

Ndizeye: Do you know that what I learned about keeping the yard and house clean and building a latrine has kept sickness away from our home. Both of my children are fat and growing. They have not often had diarrhea. I do not use charms.

Mahwa: You have a job and you can do more than what I can.

Ndizeye: Does it take money to build a latrine and to keep the yard clean? Not at all; it just takes arms. Your wife doesn't have enough arms to do it all. I help my wife, even though some laugh at me. They are my children also. I need to help them be healthy. Besides, could your wife build a latrine?

Mahwa: I guess you are right. At least it wouldn't hurt to try. Could you come and show me how to build a latrine?

Ndizeye: Of course, I'll come Saturday when we finish at 'ubumwe.' You have a hole dug and some trees cut, and I'll be there to help you.

Mahwa: Thank you in advance. I had better leave this pot of beer and go home to see how my wife is doing.

Ndizeye: Bye, I'll see you.

Narrator: Gives a summary of lesson content.

1. The man and wife must work together to build a home.
2. Prevent illness by having a clean yard.
3. Building and using a privee prevents illness.

Evaluation

All the lessons in Unit I and Lesson III of Unit V have been used and evaluated. The first four lessons of Unit I had been previously used effectively by the author in small groups of women and teen-age girls. These lessons were revised to improve their content, effectiveness for use in this curriculum. The content and visual aids were adequate, but the lessons were too long to hold attention. Four lessons were made from the material covered by one lesson previously.

The other lessons--Unit I, Lessons IV and V, and Unit V, Lesson III, were sent to Kibimba Friends Hospital, Gitega, Burundi, for use and evaluation. The lessons were taught by three health workers at the Kibimba hospital to groups of parents who brought their children for consultation at the well-baby clinic or the kwashiorkor clinic. The lessons were evaluated by an African health worker, a Murundi mother, and by a Caucasian registered nurse. The three counseled together, and a summary of their evaluation was returned. (See Appendix A.)

The evaluation of the lesson content of Unit I, Lessons IV and V, was that they were clear with adequate background for understanding. In reply to the question, "Does the lesson accomplish the objective of the lesson plan?" they expressed that behavior change was not

seen immediately but that the learners seemed receptive.

In the use of the visual aids, the puppet, the real life experience (a clean milk bottle and a dirty milk bottle), and the poster, the three evaluators indicated that they all helped to clarify the lessons. They stated that the audience was intrigued with the health worker's ability to imitate the voice and speech of an elderly woman. The posters were used appropriately and effectively. In the ease of usage, the puppet was difficult for the health worker to use because she was not accustomed to puppet usage, but the missionary nurse assisted her with the puppet. This does not present a difficult problem. A workshop for health workers would be necessary to promote this program, and during the workshop the African health workers would be familiarized with the techniques of puppet usage.

In the questions concerning participation, the lessons stimulated excellent interest and more participation than the evaluators expected. Lesson V, "It Is Better to Rear than to Deliver," stimulated a moderate number of questions, which is very unusual in an audience consisting principally of women. Lesson VI, "Bridging Between Nursing and Solid Foods," did not stimulate questions with this first usage.

The playlet, Unit V, Lesson IV, "Your Rugo," was evaluated by another set of questions. The evaluation stated that the content of the playlet was obvious to the learners. The objectives were easy to

teach because the familiar scene provided good understanding of the lesson. The interest in the playlet was excellent. In reply to the question, "Is it difficult to act the part of the characters?" they replied, "Not in the least. They are born actors! Maybe too real to be all act." During the summary, the parents who had seen the playlet asked questions about the content, and they were able to give correct answers; therefore it was felt that they understood the purpose of the playlet. The African health workers especially enjoyed using the playlet, and they wanted to know when some more playlets were going to be sent to them.

These findings indicate that this curriculum and the methods of instruction are suitable for use in parental education in Burundi, Africa. The development and duplication of the visual aids and the printing of lesson booklets, in order to make this health education program available to health workers, would necessitate sponsorship by an interested organization. Before printing the lessons in a booklet, each lesson should be used, evaluated, and necessary revision made to assure an effective curriculum.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

Summary

The review of the literature gives an historical perspective of kwashiorkor until 1952. Since then the research has mushroomed. The review has been directed to the biochemical aspects of some symptoms of kwashiorkor.

Many of the early health workers in Africa confused kwashiorkor with pellagra. Dr. Ceciley Williams (1933) first described kwashiorkor and noted that the disease developed upon discontinuation of breast feeding while the child is receiving a high carbohydrate diet. She differentiated this from pellagra by the fatty livers, found upon post-mortems, the atypical skin changes, and the absence of neurological signs (145).

An important milestone was the action of the Joint FAO/WHO Expert Committee on Nutrition to have Drs. Brock and Autret to conduct a survey of the countries south of the Sahara to study the etiology of kwashiorkor and dietary habits. They established the symptoms of

kwashiorkor and observed that it was practically nil where meat and milk were common foods; but where yams, bananas, corn, and cassava were staple foods the incidence of kwashiorkor was high. The etiology was a protein factor (146).

With new biochemical knowledge, it has been possible to relate symptoms of kwashiorkor to the failure of a metabolic process caused by the deficiency of dietary protein. Waterlow postulated that organs with high protein turnover would show the greatest effect in protein depletion. The target areas are the plasma proteins, the acinar cells of the pancreas, the liver, and the intestinal mucosa (147).

The work of Cohn, Hanson, Fletcher, and Truswell (148, 149, 150, 151) supported the hypothesis that reduced hepatic synthesis of the protein moiety of plasma lipoproteins is the major pathogenic mechanism of the fatty liver found in kwashiorkor. The edema of kwashiorkor was long been attributed to plasma protein levels less than 5.5 grams/100 ml. The simple osmotic effects of low plasma albumin cannot be the sole factor since edema does not occur in marasmic children who have low plasma albumins. Srikantia and Gopalan (152) postulated that ferritin has an antidiuretic action which is mediated through the posterior pituitary. Ferritin has been found to be present during kwashiorkor, disappearing from the circulation upon treatment, and it has not been found in children with marasmus.

Pancreatic studies showed early changes in the acinar cells

which impaired the secretion of chymotrypsin, trypsin, lipase, and amylase. The pancreatic functions return to normal except in the chronically malnourished. Early pathology is seen in the intestinal mucosa with a severe reduction in the villi-crypt ratio. This reduction affects the secretion of beta-galactase for hydrolyzing lactose. The changes in the pancreas and intestinal mucosa are responsible for malabsorption and the symptoms of diarrhea and stearrhea.

Later pathology is enzymatic defects in the metabolism of the amino acids: histidine, phenylalanine, tyrosine, and tryptophan. The defects in these enzymes occur after the symptoms of mental retardation and depigmentation.

Vasantha of India (153, 154) determined the factors involved in "crazy pavement" dermatosis. Her studies show a preferential loss collagen in the dermal tissue. The tyrosine found in the collagen was markedly reduced, which impaired the maturation and integrity of the skin, thus producing dermatosis in areas of mechanical stress.

The cause of depigmentation of the skin and hair has not been determined but is thought to be related to tyrosine, tryosinase or the cofactors of zinc and copper. The differences in ethnical groups have made it difficult to study these factors.

In the world today one of the most prominent problems which faces mankind is the challenge of feeding the increasing population of the world. In many of the developing countries, it is difficult to keep

food production increasing at the same velocity as population. In Africa poor nutrition is prevalent among the preschool age children. This is indicated by a high morbidity and mortality rate in children under five years of age. In Burundi, Africa, the problem of malnutrition and kwashiorkor is acute. A study of 100 preschool children with normal weight gains showed that the death rate among their siblings was 217 to 1,000 live births (155). Among these deaths, 36 to 1,000 live births were directly attributed to kwashiorkor.

The purpose of this study was to develop an acculturated health program for use by African health workers, stressing the prevention of malnutrition in the preschool age child. In developing the lessons the following factors were considered: high illiteracy rate, poor picture perception, low level of comprehension of lesson material, difference in disease concepts, material which can be used in open-air meetings, and high distraction factors. The lessons are short and are designed to maintain interest. The visual aids used were: posters depicting familiar scenes and objects; hand puppets resembling Barundi people; real life experiences; and playlets whose scenes are from everyday life.

The curriculum consists of five units of varying length. The six lessons of Unit I cover the nutritional needs of the child. Unit II has five lessons which are about the sanitation standards and their role in preventing illness. The five lessons in Unit III refer to the

care and prevention of infectious diseases. Unit IV consists of five lessons on caring for minor illnesses and on early detection of kwashiorkor. The three lessons of Unit V deals with improving the home and with the family working together as a unit.

Lessons containing each type of visual aid were sent to Kibimba Friends Hospital, Gitega, Burundi. The lessons were used by African health workers in the clinic. The lessons were favorably evaluated by an African health worker, a Murundi mother, and a Caucasian registered nurse.

A description of Burundi was given which related some of the cultural, socioeconomic and educational aspects of the country that would influence the health of the people. Burundi, a newly independent state, located in the most densely populated area of Africa, affords little opportunity for development with limited natural resources available. The people receive their livelihood from farming their small plots of land. Cash crops of coffee and cotton furnish them with their annual income of approximately $53.00. Educational opportunities are limited with only one out of fifteen children able to go to school, and only one out of every five hundred able to go on to secondary school. There is one two-year university in the capital city of Bujumbura. Compared with other cultures of the world there are relatively few cultural and religious taboos to be altered in order to have an effective health program. The major problems are the

socioeconomic and educational levels of the people.

Composition of the common foods of Burundi was compiled. The nutritional requirements of infants and the preschool age child were discussed with recommended alterations to their present diets. A brief discussion of protein utilization and suitable proteins for the treatment of kwashiorkor was given.

Recommendations

The teaching curriculum has been completely developed but should be translated in the French and Kirundi languages and printed in booklet form for use by health and home economic workers. The lessons must be used in Burundi and further evaluated to test their reliability and validity.

Another recommendation is that similar programs dealing with other major health programs be developed. This study could serve as a model for developing such teaching programs. Suggested areas for development include: prenatal care and nutrition; preventing and caring for the tuberculosis patient; and prevention of deformity in the leprosy patient.

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APPENDICES

APPENDIX A

Questionnaires of Tool Evaluation

QUESTIONNAIRE FOR TOOL EVALUATION

LESSON TITLE: Better to Rear than to Deliver

INSTRUCTOR: Ntabakobga

Lesson Content

Please answer the questions with complete sentences to help evaluate the effectiveness of the lesson and visual aids.

1. Q. Is the lesson material easy to understand?
   A. The lesson was given plainly with enough background that the women understood well.

2. Q. Does the lesson accomplish the objectives of the lesson plan?
   A. Time will tell better how much the learners will follow the instructions but some seemed glad to learn about these things.

3. Q. Are the visual tools readily coordinated with the lesson?
   A. All of the visual tools were used at the proper time and made the lesson clear.

Implementation

4. Q. Are the visual tools easy to use?
   A. The puppet was difficult for the African health worker to use. She used the voice of an elderly lady which intrigued the learners.

5. Q. Are the visual tools clear and understandable?
   A. Yes, their message got across to the women.

Participation

Circle one which most nearly describes the participation.

7. Was interest manifest by the participants?

None Fair Good Excellent

8. Did the lesson stimulate participation?

None Fair Good Much

9. Did the lesson stimulate questions?

None Fair Good Excellent

QUESTIONNAIRE FOR TOOL EVALUATION

LESSON TITLE: Bridging Between Nursing and Solid Foods

INSTRUCTOR: Congera

Lesson Content

Please answer the questions with complete sentences to help evaluate the effectiveness of the lesson and visual aids.

1. Q. Is the lesson material easy to understand?
   A. The lesson was plain and with enough background to make it understandable.

2. Q. Does the lesson accomplish the objectives of the lesson plan?
   A. Time will tell better how much the learners will follow the instructions but some seemed glad to learn about these things.

3. Q. Are the visual tools readily coordinated with the lesson?
   A. The posters were clear and well used.

Implementation

4. Q. Are the visual tools easy to use?
   A. They were easy to use and effective.

5. Q. Are the visual tools clear and understandable?
   A. Yes, their message got across to the women.

Participation

Circle one which most nearly describes the participation.

7. Was interest manifest by the participants?

None Fair Good Excellent

8. Did the lesson stimulate participation?

None Some Moderate Much

9. Did the lesson stimulate questions?

None Some Moderate Many

QUESTIONNAIRE FOR TOOL EVALUATION

PLAYLET: YOUR "RUGO"

Please answer the questions with complete sentences to help evaluate the effectiveness of the playlet.

1. Q. Is the content of the play easy to understand?
   A. The content was very obvious.

2. Q. Does the play teach the objective of the lesson?
   A. A familiar scene with a good understandable lesson taught.

3. Q. Is it difficult to act the part of the characters?
   A. Not in the least, they are born actors! Maybe too real to be all act.

Circle one which most nearly describes the participation.

4. Did the parents manifest interest during the play?

   Poorly Some Good Excellent

5. Did the parents understand purpose of the play?

   Poorly Partly Good Excellent

APPENDIX B

Visual Tools

Plate 1. The food chart is the visual tool for Unit I: lessons 1 through 4 which depicts foods commonly grown and utilized in Burundi.

Plate 2. A puppet representing an elderly Murundi lady who gives advice in feeding and weaning infants. (Unit I: lesson 5.)

Plate 1. The weight chart compares the weight and the development of infants at one day, six months and one year of age. (Unit I: lesson 5.)

Plate 4. A puppet family was developed for use in classes in health education. The infant in the lower right corner has kwashiorkor. (Unit II: lesson 5; Unit III: lessons 1, 2, 4, and 5; Unit IV, lessons 4 and 5; Unit 5: lessons 1c and 2.)

Plate 5. A poster of a nutritional bridge which demonstrates the difficulties an infant must overcome in order to prevent malnutrition in early childhood. (Unit I: lesson 6.)

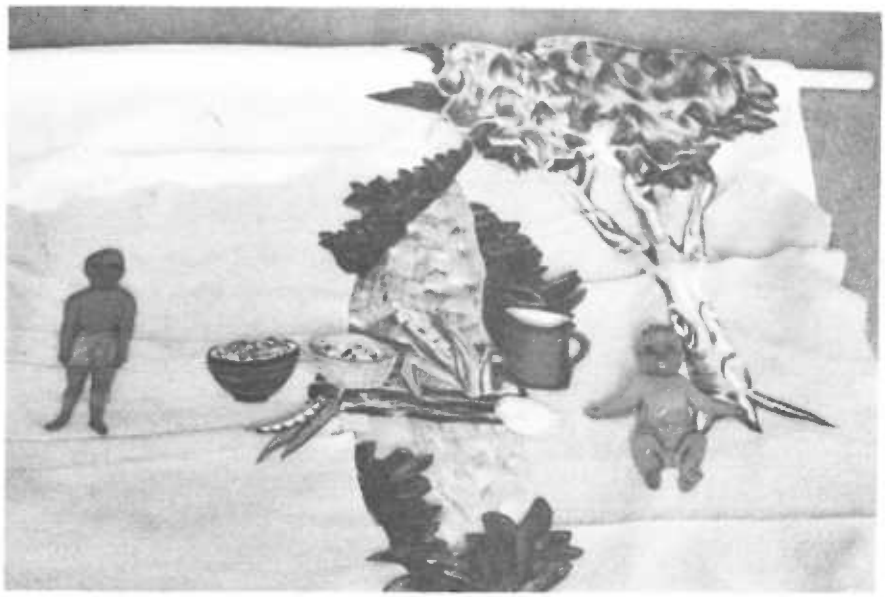

Plate 6. A poster of a nutritional bridge showing the foods which can be utilized in the prevention of malnutrition. (Unit I: lesson 6.)

Typed by Donna L. Olson

AN ABSTRACT OF THE THESIS OF

TWILA R. JONES

For the MASTER OF SCIENCE in NURSING EDUCATION

Date of receiving this degree: June 9, 1972

Title: THE DEVELOPMENT OF TEACHING TOOLS ON THE PREVENTION OF MALNUTRITION FOR THE PEOPLE OF BURUNDI, AFRICA

Approved: [redacted]
(Professor in Charge of Thesis)

The purpose of this study was to develop an acculturated health program for use by African health workers, stressing the prevention of malnutrition in the preschool age child.

The review of literature gives an histrocial perspective of kwashiorkor until 1952. Since then the research has mushroomed. The review was directed toward the biochemical aspects of some common symptoms of kwashiorkor. With new biochemical knowledge, it has been possible to relate symptoms of kwashiorkor to the failure of a metabolic process caused by the deficiency of dietary protein. The organs and tissue with high protein turnover show the greatest effect in protein depletion. The target areas are: plasma proteins, acinar cells of the pancreas, liver, and intestinal mucosa.

In the world today one of the most prominent problems which faces mankind is the challenge of feeding the increasing population of

the world. In many of the developing countries, it is difficult to keep food production increasing at the same velocity as population. In Africa poor nutrition is prevalent among the preschool age children. This is indicated by a high morbidity and mortality rate in children under five years of age. In Burundi, Africa, the problem of malnutrition and kwashiorkor is acute.

A description of Burundi was given which related some of the cultural, socioeconomic, and educational aspects of the country that would influence the health of the people. The socioeconomic and educational levels of the people are the major factor affecting a health program rather than the cultural and religious taboos.

The composition of common foods of Burundi was compiled. Recommended alterations to present diets for infants and preschool age children were given. A brief discussion of protein utilization and suitable proteins for treatment of kwashiorkor followed.

The development of an acculturated health program stressing the prevention of malnutrition in the preschool age child, is one method of alleviating the problem. In preparing the curriculum the following factors were considered: high illiteracy rate, poor picture perception, low level of comprehension of lesson material, difference in disease concepts, material which can be used in open-air meetings, and high distraction factors. The lessons are short and designed to maintain interest. The visual aids used were: posters depicting

familiar scenes and objects, hand puppets resembling Barundi people, real life experiences, and playlets whose scenes are from everyday life.

The curriculum consists of five units of varying length. The six lessons of Unit I cover the nutritional needs of the child. Unit II has five lessons which are about the sanitation standards and their role in preventing illness. The five lessons in Unit III give the care and prevention of infectious diseases. Unit IV consists of five lessons on caring for minor illnesses and on early detection of kwashiorkor. The three lessons in Unit V deal with improving the home and with the family working together as a unit.

The lessons were evaluated by sending samples of lessons containing each type of visual aid to Burundi. An African health worker, a Murundi mother, and a Caucasian registered nurse jointly used the materials and evaluated the lessons and found them satisfactory.