SOME OBSERVATIONS ON THE DEVELOPMENT OF KWASHIORKOR

A STUDY OF 205 CASES

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Kwashiorkor is at present considered to result from protein deficiency[6] in the diet of the infant and toddler, and it is known that the substances responsible for its cure are to be found in skimmed cow's milk.[3] The purpose of this study is to determine the importance of various possible etiological factors.

The 205 cases of kwashiorkor were admitted to one of the Bantu children's wards of the Pretoria Hospital during the period January 1954 to December 1955. The schedule of treatment has been outlined in previous communications.[3, 14] There was a 15% mortality (31 deaths) but, if fatalities occurring within 48 hours are omitted, the mortality rate is reduced to 9%.

I. *Age and Sex*

The age incidence is indicated in Table I, and, although the parents are often undecided about the age of the infant, the figures presented, correspond well with those of other authors;[17] 67% of cases were between 1

TABLE I. AGE DISTRIBUTION OF 205 CASES

Age (years)	*No. of Cases*
0—1	26 (12·7%)
1—2	138 (67·3%)
2—3	30 (14·6%)
Over 3	11 (5·4%)

and 2 years and 82% between 1 and 3. The age limits for admission were 6 months and 5 years respectively. The opinion has been expressed[23] that this syndrome occurs more frequently in boys than in girls and that girls are usually older when the syndrome develops. Of our cases 110 (53·7%) were boys, and the average age at admission was 22 months for boys and 21 months for girls, The series is too small to admit of a definite conclusion.

II. *Race*

In this series 200 were Bantu children and 5 were Coloured. The Coloured population of Pretoria is small. There were no Indian patients in spite of the relatively large Indian population. European cases are rare; usually less than 4 are seen per year.

III. *Diet*

1. *Carbohydrate.* The main article of diet of the Bantu in this region is mealie-meal porridge and the children received as much of it as they desired 2 or 3 times a day. In addition some received a slice of white bread 2 or 3 times a week.

2. *Protein:*

(*a*) Meat. Few families could afford meat more than once a week, with the result that the children received a minimal amount of this commodity.

(*b*) Milk. The majority of children received no milk. The few lucky ones got a maximum of 2 or 3 cups per week.

(*c*) Fish. The Bantu in Pretoria rarely if ever eat fish.

(*d*) Eggs. The children seldom get eggs to eat. Some families have a few chickens but the men often consume the eggs that are not sold. Some of the Bantu tribes apparently believe that eggs are bad for children and women.

3. *Vegetables and Fruit.* Most families have vegetables only with their Sunday dinner. The children seldom get fruit, but oranges are occasionally available.

4. *Breast-feeding.* 12 cases were still being partially breast-fed on admission. One baby of 15 months was entirely breast-fed but, as a test feed was not done, it is difficult to substantiate our impression that the breast was merely proffered as a dummy.

5. *Weaning.* The disease usually developed 1-6 months after cessation of breast-feeding. This corresponds with Brock and Autret's observation[2] that the syndrome usually develops during the late breast-fed, weaning and post-weaning periods.

IV. *The Social Background*

The incidence of kwashiorkor parallels that of poverty, with ignorance adding its quota.

1. *The Income of the Head of the Family.* In only 87 cases was the mother aware of her husband's income. The average was £10 per month with a scatter of £2 to £36. Approximately 1/3rd of the mothers also worked Many of these had been deserted and were employed as domestic servants earning £2-£5 per month with board and lodging for themselves only.

2. *The Size of the Family.* The average number of living children was 2·2 per family. Many families had lost one or more children. Furthermore, although the number of living children was so surprisingly small many fathers also supported other relatives.

3. *The Number of Fathers actually Supporting their*

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Families. In only 120 cases information regarding the fathers' activities could be obtained: 25 had disappeared, 7 had died, 3 were unemployed and 1 was in a mental hospital, while 5 mothers were unmarried, Thus, in only 79 families were the fathers responsible for their support and in the remaining cases the mothers were forced to leave the children in the care of relatives or friends while they went out to earn money.

4. *Number of Cases where Relatives were the sole Support.* In 43 out of the 200 Bantu cases, relatives were totally responsible for the children. Usually it was one or other of the grandparent pair. This occurred especially where both parents were working or where the father had deserted. It can readily be conceived that the grandparents either through poverty, ignorance, superstition or old age failed to give the children the necessary care. Trowell, Davies and Dean[18] mentioned the possibility of the separation of child and mother being etiologically important, in that the loss of security so produced could cause anorexia. It is accepted[7] that the absence of the Mother-figure not only leads to psychic trauma but also to physical retardation. Whether this is important in the etiology of kwashiorkor remains an open question.

5. *Housing.* The housing is extremely poor. Often the family as well as relatives or even friends share 1 or 2 rooms. Sachs[15] emphasized the importance of environment; he points out that with a poor diet a mild degree of malnutrition may result, but if the environment is poor, especially under unhygienic conditions, gastro-enteritis followed by nutritional oedema may occur.

V. *The Role of Infection*

On admission, many of the cases show evidence of infection. This may play a part in the development of the syndrome, or it may be a precipitating factor. Another possibility is that it develops as a result of lowered resistance.

1. *Infection of the Respiratory System:*

(*a*) Ear, Nose and Throat. A large proportion of the cases had a nasal discharge, which cleared with recovery. At times the throat was red and injected. The appearance of the tympanic membrane was characteristic. In practically every instance it was dull-grey in appearance, with no light reflex. Malnutrition may be the cause, but we usually regard it as evidence of low-grade infection. Of the 13 cases in which post-mortem examination was done, 3 showed mastoiditis and 2 bilateral otitis media. We feel that middle-ear infection in cases of kwashiorkor should receive more attention.

(*b*) Pulmonary Infection (non-tuberculous). On clinical examination 16 cases were diagnosed as having bronchitis or pneumonia. Roentgen examination revealed a further 11 cases of pneumonia. These were all Mantoux-negative.

(*c*) Tuberculosis. In 190 cases Roentgen photos of the lungs were taken and a Mantoux test (PPD second strength) done soon after admission. Only 7 cases were Mantoux-positive, and 4 of these had radiological evidence of tuberculosis. Roentgen examination revealed lesions suggestive of pulmonary tuberculosis in a further 20 cases. The commonest lesion was a primary complex, but collapse, broncho-phneumonia and cavity formation were also encountered. One case had tuberculous spondylitis. At post-mortem examination 1 further case of tuberculosis was discovered.

2. *Congenital Syphilis.* Kolmer complement fixation and Price precipitation tests were done on 200 of the cases; 192 were frankly negative while 3 cases were positive (qualitative precipitation-test positive and Kolmer test 128 units). The remaining 5 cases showed various discrepancies and were of such low titres that the serological diagnosis was in doubt. None of the cases showed any clinical signs of congenital syphilis. Janssen and le Roux[9] obtained positive results in 5 out of 101 cases. Gillman and Gillman[8] found a strongly positive Wassermann reaction in 16 out of 60 adult 'pellagrins' and in 2 out of 22 'infantile pellagrins'. Harris (quoted by Gillman and Gillman[8]) reported positive W.R. in many Negro 'pellagrins' in America.

3. *Gastro-intestinal Infections:*

(*a*) History of Diarrhoea. Out of 200 cases 95 gave a history of diarrhoea, but in many cases the history was not reliable. Unfortunately it was not possible to establish the presence of diarrhoea in all cases, but the majority of those examined had loose stools.

(*b*) Investigation of Faeces. The faeces of 180 cases of kwashiorkor were examined:

(i) Macroscopic appearance. In 72 cases the specimens were loose and watery and in many instances green.

(ii) Microscopic examination. This was done according to the methods of Bates and Alberto[1] and Joseph,[10] and 141 specimens showed no abnormality. The remaining 39 cases showed the presence of scanty pus cells and/or red blood-cells. *Trichomonas hominis* was present in abundance in 12 of the 39 cases. In one of these cases the vegetative form of *Balantidium coli* was found, in another that of *Giardia lamblia* and in a 3rd case encysted forms of *Entamoeba histolytica* were present. Ova of *Ascaris lumbricoides* were present in one case.

(iii) Pathogenic organisms. The cause of diarrhoea in kwashiorkor is as yet uncertain. Trowell, Davies and Dean[19] mention the possibility that certain types of diet may play a role, e.g. those that contain an excess of cane sugar or mealie-meal. It has however been demonstrated[16] that these patients have a diminished secretion of digestive enzymes, and that this may be an important cause of diarrhoea.[21] To establish whether infection plays a role the faeces of 180 cases were cultured for shigella and salmonella organisms according to the method outlined by Coetzee and Scott.[5] In 10 cases various shigellas (mostly of the flexner type) were isolated, while in 3 cases salmonellas were cultured. In 1954 4 cases were investigated for the presence of 'pathogenic' *Escherichia coli.* These were present in all 4 cases (3 had double infections); the types isolated were 055B5, 0119B?, 0128B12, and 026B6. Coetzee and Pretorius[4] demonstrated that these strains of *E. coli* are frequently found in cases of gastro-enteritis in Pretoria, and there is no

reason to believe that cases of kwashiorkor are less susceptible to infective diarrhoea. Mild cases of malnutrition may possibly develop serious symptoms when gastro-enteritis supervenes. It has been shown that the 'pathogenic' strains of *E. coli* occur in healthy carriers[13] and the possibility that gastro-enteritis will develop if their resistance is lowered has been mentioned.[24] Babies harbouring these strains develop diarrhoea on a change of diet or on contracting an upper-respiratory-tract infection.[24] It appears reasonable to consider that the resistance of cases of kwashiorkor is lowered, especially as many of them suffer from upper-respiratory-tract infections, and we regard it as important to determine the role of *E. coli* in the occurrence of diarrhoea in cases of this disease. We are at present engaged on a study of this.

4. *Infection of the Urinary Tract:*

The urine of 185 cases was examined microscopically after centrifugation and for the presence of albumin. Albuminuria was found in 75 (40%) (see Table II)

TABLE II. ALBUMINURIA

Albumin	*No. of Cases*
Negative	110 (60%)
Trace	33
1+	13
2+	14
3+	9
4+	6
Total	185

and this agrees with the experience of others[9, 22] that albuminuria occurs frequently. Pus cells were seen in 124, usually 2-10 per high-power field, while an additional 16 had a frank pyuria. In 55 of the 124 with pus cells red blood-cells were also present (2-8 per high-power field). No bilharzia ova were ever detected. In 15 cases (8%) the urine specimens contained casts; 7 were hyaline, 5 granular and the specimens

TABLE III. RESULTS OF URINE CULTURES

Organisms	*No. of Isolations*
Sterile	10
Escherichia coli	29
Proteus vulgaris	5
Proteus mirabilis	2
Proteus rettgeri	1
Pseudomonas aeroginosa	6
Micrococcus pyogenes (Coagulase-positive)	5
Achromobacter	5
Paracolon	4
Alpha haemolytic streptococci	2
Total	69

of 3 cases contained both varieties. In 54 cases with microscopic evidence of urinary infection the urine was cultured. Results are set out in Table III. In some instances more than one organism was isolated. The well-known difficulty of obtaining an aseptic specimen from young children renders the interpretation of the findings difficult but we feel that urinary infection occurs fairly frequently in these patients, although the relationship to kwashiorkor is undetermined.

VI. *Parasitism*

Formerly, in certain parts of the world, kwashiorkor was thought to occur entirely as a result of parasite infestation,[20] and even today some authors[6, 11] consider it important etiologically. In some parts the incidence of parasitism is low and its importance in kwashiorkor is discounted.[12]

In Pretoria and environs malaria does not occur to any great extent and none of our cases showed evidence of this disease. The presence of helminths was established from the history in 16 cases and in one instance ova of *Ascaris lumbricoides* were seen in a microscopic examination. Parasitism does not appear to play an important role in this area.

SUMMARY AND DEDUCTIONS

Kwashiorkor is a deficiency syndrome, certainly of protein and possibly of other nutrients as well. Protein foods are expensive, so that where socio-economic conditions force the purchase of the cheaper carbohydrate foods (mealie-meal in this area) protein deficiency must arise.

The moment the supply of breast-milk diminishes or the baby is weaned, the stage is set for the development of kwashiorkor. These patients suffer great disabilities. Their digestive capacity is impared owing to a diminution of enzyme secretion—a possible cause of the diarrhoea. Secondly, they certainly seem very prone to infection. Whether infection plays an etiological role is undecided but it seems reasonable to consider that by creating greater demands for nutrients, especially proteins, it is important in the etiology of kwashiorkor.

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