"Kwashiorkor" and "Marasmus" in Jamaican infants

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SUMMARY

For purposes of this analysis the syndrome of "marasmus" was defined by a body weight less than half expected for age in a child without oedema or skin depigmentation. A malnourished child was said to have "kwashiorkor" if he had gross oedema, skin depigmentation and an enlarged liver.

A series of 343 severely malnourished Jamaican children contained only 71 cases of marasmus and 39 of kwashiorkor as defined above. The remaining 233 children showed intermediate clinical forms.

The children with kwashiorkor did not differ significantly from those with marasmus in age, haemoglobin concentration, serum sodium concentration or mortality, but they were heavier, taller and had a lower serum protein concentration. In all these respects the range of values for the two groups overlapped widely.

Kwashiorkor and marasmus are not clinical entities but the extremes of a continuous but disorderly spectrum of infantile malnutrition. Our evidence suggests that in Jamaica marasmus is usually the result of chronic undernutrition, and kwashiorkor may be a result of transferring a fairly well fed child onto a very low protein diet.

A child who dies of malnutrition may show no clinical signs other than extreme wasting and stunting of growth. At autopsy the subcutaneous fat is almost completely absent and the muscles are atrophic, but there is otherwise nothing very remarkable. There is no oedema, no depigmentation of the skin or hair and little, if any, fatty infiltration of the liver.

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To this clinical picture the name marasmus may be applied, and it will be understood by paediatricians in all parts of the world.

In some parts of the world marasmus is relatively uncommon, and instead children with severe malnutrition usually show a syndrome characterised by gross oedema and depigmentation of the skin and hair. The subcutaneous fat is often well preserved and the liver may be greatly enlarged as a result of fatty infiltration. This picture is so different from that of marasmus that a different name must be attached to it; often it is called kwashiorkor, but numerous alternative names are listed by Trowell, Davies and Dean (1). The condition called kwashiorkor always involves stunting of growth and gross oedema, but the severity of changes in the skin, hair, liver and subcutaneous fat vary from country to country; some of these regional differences have been summarised by Waterlow and Scrimshaw (2).

If malnourished children usually conformed to one or other of the clinical types described above there would be no need for confusion, but, in fact, in some countries the majority of cases fall into an intermediate group for which terms such as "marasmic kwashiorkor" (3) have been used, and all these types form a continuous spectrum (4). The Mexican workers (5) make no distinction between oedematous or non-oedematous children, and classify all malnourished children as first, second or third degree malnutrition according to the weight of the child compared with that of a normal child of the same age. Nevertheless, the name "kwashiorkor" and "marasmus" persist, and in a recent review Dean (6) lists the characteristics of the two conditions. Apart from the features mentioned above he stated that in kwashiorkor there is usually along history of illness, the age of the child is usually 1-3 years, and there is constantly anaemia and hypo-proteinaemia, whereas marasmus usually occurs in a child under 1 year old, after a short illness, there is vomiting and diarrhoea but haemoglobin and serum protein concentrations are normal.

We recently analysed the records of series of 343 children who were admitted to the M.R.C. Tropical Metabolism Research Unit with severe primary malnutrition (7). We therefore took this opportunity to look for answers to the following questions:

1. What proportion of this series of malnourished Jamaican children conform to the classical description of "marasmus" or "kwashiorkor"?
2. Among those who will fit one of these categories, what other characteristics do they usually show?
3. What conclusions can be drawn about actiology of the two syndromes?

Diagnostic criteria

For purposes of this investigation a child was said to have *marasmus* if he or she had the following clinical features:

a) Weight on admission was less than half that of a normal child of the same age.
b) No oedema.
c) No depigmentation of skin or hair.

A child was said to have *kwashiorkor* if he or she had the following features:

a) Gross oedema.
b) Depigmentation of skin and/or hair.
c) Enlarged liver.

Although hepatomegaly is not a constant feature of kwashiorkor in all parts of the world, it is a most important sign in the disease as it is seen in the West Indies (8).

RESULTS

Frequency of marasmus

Of the 343 children with severe primary malnutrition 133 were less than half the reference weight for age, and thus met the first requirement for the diagnosis of marasmus. However, of these 133 children, 34 had oedema, 12 had depigmentation of the skin, and 16 had both oedema and depigmentation so 71 of the series (20.7%) qualified as marasmus.

Frequency of kwashiorkor

Of the 73 children in the series of gross oedema, 11 had depigmentation but no hepatomegaly, 21 had hepatomegaly but no depigmentation, and 2 had neither of these signs. Only 16 of the 342 children had gross oedema, depigmentation, and a liver enlarged more than 5 cm. below the costal margin, a total of 39 cases (11.4%) out of the series fulfill the requirements for a diagnosis of kwashiorkor.

Characteristics of the two syndromes

The results are summarised in Table 1. The incidence of oedema and depigmentation shown is, of course, a consequence of the diagnostic criteria used to define the syndromes. For the same reason 100% of children with kwashiorkor have enlarged livers, but 42% of the marasmic children also had enlarged livers although only 3 (4%) were more than 5 cm. below the costal margin.

The difference in weight for age between the two groups is highly significant, but again this is influenced by the diag-

TABLE I

CHARACTERISTICS FOUND AMONG 71 CHILDREN WITH SEVERE "MARASMUS" AND 39 CHILDREN WITH "KWASHIORKOR"

	Marasmus	Kwashiorkor	Statistical significance
Percentage with gross oedema	0% (71)*	100% (39)*	—
Percentage with skin depigmentation	0% (71)*	100% (39)*	—
Percentage with enlarged liver	42% (71)	100% (39)*	—
Minimum % weight for age - average	42.0 (71)	62.3 (39)	$p<0.001$
- range	25.0 - 50.0*	38 - 75.0*	
% height for age - average	84.9 (71)	89.9 (37)	$p<0.001$
- range	68 - 98	79 - 96	
Age in months - average	11.67 (71)	12.50 (39)	N. S.
- range	3 - 24	5 - 28	
Serum protein g% - average	5.68 (55)	4.30 (36)	$p<0.001$
- range	2.6 - 8.6	3.0 - 5.4	
Haemoglobin g% - average	8.71 (70)	8.61 (38)	N. S.
- range	4.1 - 14.0	3.2 - 13.2	
Serum sodium mEq/1 - average	133.6 (60)	136.3 (38)	N. S.
- range	106 - 157	114 - 157	
Percentage mortality	11.3 (71)	17.9 (39)	N. S.

* These figures are determined by the definitions used for "marasmus", "kwashiorkor" and "severe infantile malnutrition".
The figures in brackets indicate the number of children on whom the observations were made.

nostic criteria. Marasmic children had, by definition to be less than 50% of reference weight for age and kwashiorkor children had to be grossly oedematous, so a significant difference in weight between the groups is to be expected. The weight given in table is calculated from the *minimum* weight attained by the child during his stay in hospital in order to try to reduce the effect of oedema, but the correction is by no means perfect.

The remaining characteristics shown in the Table are largely independant of the diagnostic criteria used, and so provide a valid basis for comparing the two syndromes. Contrary to the statement of Dean (6) there is no significant difference in the age or haemoglobin concentration between the two groups: the children with kwashiorkor are on average about 1 month older, and have 0.1 g% less haemoglobin than the marasmic children, but these differences are totally insignificant compared with the widely overlapping ranges found in the two groups.

These results also contradict the suggestion that kwashiorkor is the result of a longer period of malnutrition than is marasmus. If one is presented with two malnourished children of the same age it is not easy to say which has been malnourished for the longer period. Our experience in Jamaica is that usually the history of illness in marasmus is longer than that in kwashiorkor, but this is an unreliable guide. More convincing evidence is given by the finding (see Table I) that children with marasmus are highly significantly shorter for their age than those with kwashiorkor. Malnutrition cannot cause a child to lose height, so in general the deficit in height is a good index of the chronicity of the malnutrition, whereas deficit in weight may be equally well due to long standing malnutrition of moderate degree or acute but severe malnutrition. Here also our experience differs from that of Dean, as it appears that in Jamaican children kwashiorkor is the result of a more acute period of malnutrition than is marasmus.

Concerning serum protein concentration we support Dean's statement that values in kwashiorkor are lower than in marasmus on the average, but it is not true to say of our cases of marasmus that their protein concentration is normal. Although the average values of 5.68 and 4.30 g./100 ml. are

highly significantly different, the range of values found among marasmic children embaces the whole range of the kwashiorkor values.

DISCUSSION

It is obvious that kwashiorkor and marasmus as seen in Jamaica, are very different from the descriptions given by Dean (6), and that the two syndromes in any case describe only a minority of our series of malnourished children. The majority of our cases, 233 out of 343, showed some of the features of both types, but it is not possible to place a given child exactly on the spectrum between the two extremes, because, for example, he may show gross oedema without skin changes, or vice-versa. The fact that the line of demarcation between kwashiorkor and marasmus is difficult to establish within the continous spectrum of signs has been stressed previously (11). The moral is that it is no more accurate to use the terms "kwashiorkor" and "marasmus" than it is to speak of "big cars" and "small cars"; local experience in different parts of the world will greatly influence the way in which such descriptions are interpreted. It is, of course, legitimate and convenient to use such terms when they have been defined in an unambiguous manner.

So striking is the difference between the clinical appearance of children at opposite ends of the spectrum of malnutrition, that one is impelled to try to explain the factors responsible for this difference. In our series the relevant facts are that the kwashiorkor children are heavier and taller but have a lower serum protein concentration and somewhat higher mortality than the marasmic children. It has also been shown that children of the kwashiorkor type are more potassium depleted (9) and show a proportionately greater loss of visceral protein but have more subcutaneous fat (10) than marasmic children. It was noted by Waterlow *et al.* (12) that there is a correlation between the degree of fatty infiltration of the liver and the height of a malnourished child. We interpret these facts to mean that kwashiorkor is probably the end product of a weight curve like that marked K in Fig. 1. We derive some support for this hypothesis from the dietary history of a girl aged 11 months who was admitted to the

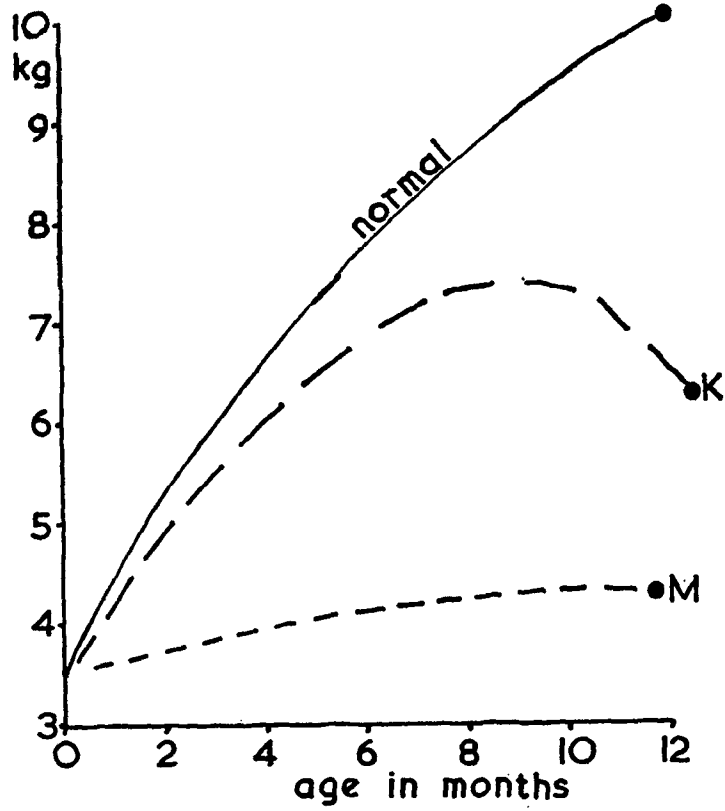

Fig. 1.—Hypothetical weight curves for the first year of life of a normal child, and of a child who develops kwashiorkor (K) or marasmus (M).

Unit with gross oedema, a very large liver (which was shown by needle biopsy to contain 48% fat) and the classical cutaneous lesions of kwashiorkor. Until one month previously she had been well nourished; since then her mother, who had misinterpreted advice which had been given to her by a doctor, had given the child 80 g. per day of sugar as her only source of calories. Such a case is, of course, exceptional, but it indicates that kwashiorkor can be produced in one month by changing a young child from an adequate diet onto a protein free one.

Marasmus, on the other hand, is obviously not usually the result of so short a period of deprivation. In Fig. 2 the height

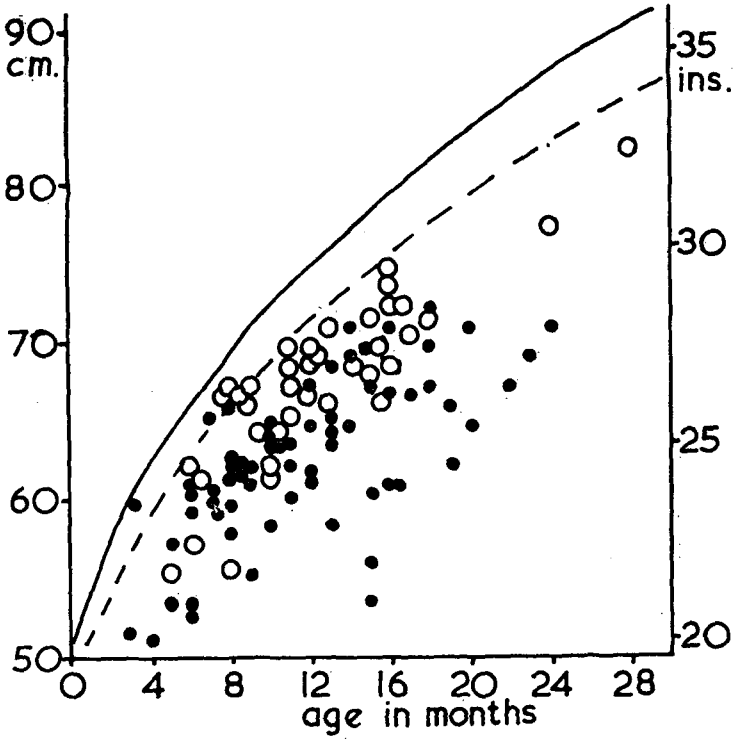

Fig. 2.—Scatter diagram of the height and age of 39 children with kwashiorkor (open circles) and 71 children with marasmus (solid circles). Also shown is the height-for-age curve of children on the 50th percentile for Boston children (solid line) and on the 3rd percentile (broken line).

of the marasmic and kwashiorkor children are plotted against their age, and the distribution is compared with the 50th and 3rd percentile for Boston children (13). The average marasmic child aged 12 months is about the same height as a kwashiorkor child of 9 months, and in the older age groups the height deficit among marasmic children is still greater. This observation is consistant with the view that marasmus is probably the end product of a weight curve more like that marked Min Fig. 1.

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RESUMEN

Para el propósito de este análisis, el síndrome "marasmo" fue definido por un peso corporal menor de la mitad esperada para la edad de un niño sin edema o piel despigmentada. Se consideró que un niño desnutrido tenía "kwashiorkor" si presentaba edema franco, despigmentación de la piel e hígado agrandado.

En un grupo de 343 niños severamente desnutridos se encontraron solamente 71 casos de marasmo y 39 de kwashiorkor, identificados de acuerdo con la definición anterior. Los otros 233 niños presentaron formas clínicas intermedias.

Los niños con kwashiorkor no diferían significativamente de aquellos con marasmo, en cuanto a edad, concentraciones de hemoglobina y sodio sérico, pero tenían un peso mayor, eran de más estatura y tenían una concentración de proteínas séricas más baja. En todos estos aspectos, dentro de los límites de valores para los dos grupos, existía un alto grado de coincidencia.

Kwashiorkor y marasmo no son entidades clínicas, sino los extremos de una continua pero desordenada gama de desnutrición infantil. Nuestra evidencia sugiere que, en Jamaica, el marasmo es el resultado de una mala nutrición crónica y kwashiorkor puede ser el resultado de transferir a un niño bien nutrido a una dieta muy baja en proteína.

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