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Feeding practices and malnutrition at the Princess Marie Louise Children's hospital, Accra: what has changed after 80 years?

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Abstract

Background: Sub-optimal feeding practices are associated with malnutrition. In 1933, Dr Cecily Williams, while working at Princess Marie Louise Children's Hospital (PML) in Accra described Kwashiorkor as the disease of children "deposed" from breast feeding who were being fed plain fermented maize diets. Presently, it is not clear how this has changed after 80 years.

Methods: We conducted an unmatched case-control study at PML in 2013 in order to determine faulty feeding practices associated with malnutrition. PML is a 74 bed children's hospital and the largest centre for treating children with malnutrition in Ghana. Under-fives with Moderate or Severe Acute Malnutrition (SAM or MAM) were selected as cases while the controls were children without SAM or MAM.

Results: A total of 182 malnourished and 189 well-nourished under-fives and their mothers were studied. Faulty feeding practices including early weaning, shorter duration of exclusive breastfeeding, mixed feeding, bottle feeding and limited consumption of fruits were found. Though the use of "iced kenkey" a maize-based diet was limited, over one-third of malnourished children (39.1 %) were still being weaned with plain unfortified fermented maize gruel both of which Dr Williams associated with Kwashiorkor. Well-nourished children were more likely to receive solid food (38.0 %), fortified maize gruel (29.2 %), and Cerelac® (24 %) a processed cereal-based complementary food. A child's refusal to breastfeed was the most common reason for stopping breastfeeding among malnourished children.

Conclusions: More effective nutrition education and new complementary feeding diets that are wholesome yet appeal to a new generation of mothers are needed. The patho-physiology of feeding problems needs further study.

Keywords: Malnutrition, Weaning, Breastfeeding, Complementary feeding, Kwashiorkor

Background

When kwashiorkor was first described by Dr Cecily Williams as she worked as an expatriate doctor in the 1930's at Princess Marie Louise Children's Hospital (PML) in Accra, it was the disease of the "deposed" child [1]. It was associated with a maize diet and an abrupt stop to breast feeding following the onset of pregnancy. A study at the same hospital in 1994 found that malnutrition was associated with young mothers, low birth

weight, less access to breastfeeding, less feeding frequency, lower educational levels and certain occupations of the parents of these children [2].

Poor infant feeding practices predispose children to nutritional disorders which may persist into early childhood with life-long consequences. These practices, as reported from developing countries, include the use of pre-lacteal feeds, mixed feeding and lack of exclusive breastfeeding in the first six months [3–7]. Others are short duration of breastfeeding, late initiation of complementary feeding, bottle feeding and a lack of dietary diversity.

Interventions to optimise nutrition in children and prevent under-nutrition include promotion of exclusive

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breast feeding up to six months and continued breast-feeding up to two years and beyond [7–9]. In the Ghana Child Health Policy, it includes the proviso that all mothers shall be supported to provide appropriate feeding of their infants [8]. The policy together with other guidance advocates that complementary feeding should begin at 6 months of age and that the foods used should be adequate in quantity and frequency and appropriate in quality in terms of energy density, micronutrient composition and food handling [7–9]. In view of this, the United Nations Children's Fund and the Ghanaian government developed "Weanimix", a cereal-legume blend as a locally affordable and acceptable complementary food recommended for weaning [8, 10]. However, it is not clear how well this is being used by mothers in recent times.

We examined the feeding practices of malnourished children to identify faulty feeding practices and compared it with the feeding practices of well-nourished children.

Methods

Study design and sampling

The study was part of an unmatched case control study of mothers of malnourished and well-nourished children attending Princess Marie Louise Children's Hospital and their children. Earlier on, we reported the health profile of children presenting with malnutrition and the uptake of interventions to prevent the condition [11]. We have also examined maternal socio-demographic and health profiles and related it to malnutrition [12]. We present here the study of feeding practices associated with malnutrition in children under the age of 5 years. Children with Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) under the age of five and their mothers were compared with a group of well-nourished children and their mothers. Consecutive patients with MAM and SAM admitted to the malnutrition ward or referred to the nutritional rehabilitation unit were recruited into the study between 9th January and 10th September 2013 if they met the inclusion criteria.

Patients from the outpatients and other wards were also selected for inclusion if their mothers/carers gave consent and they met the inclusion criteria for either group. Using the estimated prevalence of 9 % for wasting in Ghanaian under-fives [13], a confidence interval of 95 % and 5 % percentage points or allowable error, the minimum sample size was estimated to be 126 children and their mothers in each group.

Study setting

Princess Marie Louise Children's Hospital is the largest centre for treating children with severe malnutrition in

Ghana. It receives referrals for rehabilitating children with nutritional disorders from hospitals in Accra and occasionally from other regions. It is a 74 bed children's hospital situated in the commercial centre of the capital, Accra. It had over 70,000 visits from children presenting with a variety of conditions to its outpatients department in 2012 [14]. In the same year, there were 20 in-patient admissions for Kwashiorkor, 118 in-patient admissions for Marasmus and 11 in-patient admissions for Marasmic-Kwashiorkor. The WHO protocol on The Management of Severe Malnutrition informs the standard of care and the hospital offers both primary care and specialised paediatric services which include paediatric surgery [15, 16]. Thus, it attends to patients brought in by their carers (self-referred) as well as children referred from other health care facilities.

Study population

Children under the age of five with a weight-for-height Z-score of < -2 were included in the study as malnourished children, while patients with a weight-for-height Z-score ≥ 2 presenting with other conditions were included in the comparative group. Although the Mid Upper Arm Circumference (MUAC) criteria are used to define malnutrition in the hospital, children who met MUAC criteria but did not meet weight-for-height criteria were excluded from the study. Children with a recognised cause of chronic malnutrition such as congenital heart disease, renal failure, sickle cell disease or liver disease were also excluded from both groups.

Children in the nutritional rehabilitation programme for more than 7 days were also excluded. This exclusion was meant to reduce the likelihood of mothers reporting the advice they had received from the hospital rather than their own feeding practices prior to entering the programme. In addition, children who were severely ill were excluded until they were stable, that is, if this was within the 7 days.

Controls were selected from the out-patients department and from the general paediatric wards if they had a weight-for-height Z-score of -2 or more, met the rest of the criteria for inclusion, and consent was obtained. Controls were not matched to the cases. Purposive sampling was used as we had some challenges recruiting controls especially from the general wards as many of those screened did not meet the criteria for being "well nourished" so we extended the time for recruitment.

Measurements

Weight-for-height (or length) measurements were used to classify malnutrition. Weight measurements were done using a Class III infant scale (Seca 334). Height measurements were done using a Leicester height measure while length measurements were done using a Seca

417 length board and recorded to the nearest millimetre. MUAC and head circumference were also done using non-stretch tape measures. Three trained research personnel were involved in making all measurements using standardised technique. A Royal College of Paediatrics and Child Health video clip was used as part of the training [17]. A selection of weight measurements were re-checked for consistency.

Definitions

For the purposes of this study we had the following definitions:

Malnutrition

- Severe Acute Malnutrition (SAM): Children with an admission weight-for-height < 70 % of the National Centre for Health Statistics (NCHS) median value or below - 3 Z-scores with or without bilateral pitting oedema and/or children aged 6 months and above with Mid Upper Arm Circumference (MUAC) less than 11.5 cm [16, 18]
- Moderate Acute Malnutrition (MAM): Children with a weight-for-length (or height) < 80 % but ≥ 70 % of the National Health Statistics (NCHS) median value or between -2 and -3 Z-scores and/or children aged 6 months and above with Mid Upper Arm Circumference (MUAC) of 11.5 cm to <12.5 cm [16, 18].
- Marasmus: Weight-for-length (or height) < 70 % or -3SD (non-oedematous SAM) [18].
- Kwashiorkor or Marasmic kwashiorkor: oedema of both feet (MAM or SAM with oedema) [18].

Feeding practices

- Exclusive breastfeeding requires that the infant receives breast milk including milk expressed or from a wet nurse and it allows the infant to receive oral rehydration salt (ORS), drops, syrups which are vitamins, minerals or medicines, but it does not allow anything else [19].
- Predominant breastfeeding requires that the infant receives breast milk including milk expressed or from a wet nurse as the predominant source of nourishment and it allows the infant to receive certain liquids including water and water-based drinks, fruit juice, ritual fluids and ORS, drops or syrups which are vitamins, minerals or medicines but it does not allow the infant to receive anything else, in particular, non-human milk and food based fluids [19].
- Bottle-feeding requires that the infant receives any liquid including breast milk or semi-solid food from a bottle with a nipple or teat milk and allows the infant to receive any food or liquid including non-human milk and formula [19].

- Mixed feeding requires that the infant receives both breast milk and any other food or liquid including water, non-human milk and formula before 6 months of age [20].
- In the context of this study “solids” mainly refer to solid food which is smooth, coarse, lumpy, mashed, chopped foods and finger foods which are traditionally eaten in compact form as part of the family meal. It excludes semi-solids and liquids normally regarded as solid such as smooth or pureed food including thick and thin porridges and foods whose textures may have been altered to suit the infant diet [21].

Data collection

A semi-structured questionnaire and a data record form were used to collect data on the nutritional status of the child and the mother's experience with breastfeeding. In this regard, we examined the initiation of breast feeding, the duration of breastfeeding, the practice of exclusive breastfeeding, mixed feeding and the factors influencing breastfeeding. We also examined the use of other milk feeds, bottle feeding, the age at weaning, weaning foods, the child's current diet and the presence or absence of feeding difficulties. A semi-quantitative food frequency questionnaire containing the main food groups was used as part of the data collection. The frequency of eating the listed foods was reported as daily, weekly, monthly, rarely or never with a section on further details on portion sizes and the frequency of foods eaten daily (data not included). Information on feeding problems was derived from a mother's report of whether her child was difficult to feed since parental views are important in determining problems with feeding [22]. Mothers and carers were asked whether their children had any problems which interfered with feeding their children and if yes, what was/were the cause(s) and if it is under the care of a healthcare professional. For problems with breast feeding, the mothers were asked if they had any difficulties with breastfeeding their children and if yes, what was/were the problem(s). We also asked about reasons for stopping breast feeding and among the coded reasons was a child's refusal to suck.

Weaning foods were classified into plain fermented maize gruel, solids, Cerelac®, fortified maize gruel, “weanimix”, “mpotompoto”, beverage and “iced kenkey”. Cerelac® is commercially produced, but the others are home-made foods. Plain fermented maize gruel is the same as “arkasa” which was described in detail by Dr Williams [1]. The fortified version of the gruel has milk, fish powder, soya products or peanut butter added (Table 3), in line with current recommendation to increase its protein and micronutrient content [10]. “Mpotompoto” is a traditional food prepared from tubers such as yam,

cocoyam or potatoes, vegetables, fish and palm-oil while “weanimix” is a cereal/legume blend.

Statistical methods

The weight-for-height Z-scores were calculated using the WHO anthro calculator [23]. The data were entered into a Microsoft Access database (Microsoft Corporation, Redmond, Washington) and analysed using Stata 11.0[®] (College Station, Texas 77845 USA). Frequencies were computed and the data were summarized in tables and graphs. Logistic regression was used to determine the factors associated with malnutrition and reported as odds ratios with 95 % confidence interval. Statistical significance was accepted at a 5 % probability level, that is, a *p*-value of less than 0.05.

Results

In all, 371 mother (or carer) and child pairs were studied, consisting of 182 mothers and their malnourished children and 189 mothers and their well-nourished children. We included only 4 (1 %) children who had oedematous Severe Acute Malnutrition (Marasmic Kwashiorkor). The age and sex distribution and Z-scores (weight-for-height) ‘WHZ’ of the 371 children used in the study are presented in Table 1. The ages of the children ranged between 6 months and 51 months among the malnourished children and between 6 months and 54 months in the well-nourished children. A total of 51.7 % (*n* = 94) of the malnourished children were within the 6 months to 11 months age group, while 43.4 % (*n* = 82) of the well-nourished group were between 6 months and 11 months. Among the malnourished children, 95.7 % were 2 years and below. Females constituted 50.1 % (*n* = 186) of

the study participants. The highest proportion of study participants was in the 12 to 24 months age category (*n* = 162, 43.7 %). Forty (40) out of the 95 malnourished children with feeding problems were under the care of a health care professional (HCP) compared with 17 out of 46 well-nourished children with feeding problems.

Table 1

The feeding practices of the study population are displayed in Table 2. A total of 52.2 % (*n* = 95) of the malnourished children had feeding problems compared with 24.3 % (*n* = 46) of the well-nourished children. The odds of being malnourished were 3 times higher in children with feeding problems compared with those without feeding problems (OR = 3.39, [95 % CI, 2.13-5.42], *p* < 0.001). Regarding breastfeeding in the first six months, the odds of a child being malnourished were 1.7 times higher in children with mixed breastfeeding compared with children who were exclusively breastfeeding (OR = 1.69, [95 % CI, 1.01-2.83], *p* < 0.034). There was also a significant association between the early introduction of complementary feeding and malnutrition. About one-third, 33.7 % (*n* = 58) of the malnourished children were less than 6 months old when complementary foods were added, whereas only about one-fifth, 21.2 % (*n* = 38) of the well-nourished children were less than 6 months old when complementary foods were added (OR, 1.89 [95 % CI, 1.14-3.14], *p* = 0.009). A greater proportion of the malnourished children were bottle-fed (16.3 %) compared with the well-nourished children (5.6 %) and the association was significant (OR, 3.31 [95 % CI, 1.49-7.87], *p* = 0.001) (Table 2). Frequency of egg-intake and meat/fish intake were not associated with malnutrition among the 12 to 59 months old children. However, the odds of a child (12–59 months) being malnourished was twice if the frequency of that child’s fruit intake was occasional compared with a child (12–59 months) whose fruit intake was everyday (OR, 2.10 [95 % CI, 1.08-4.11], *p* = 0.018) (Table 2).

Table 1 Age and Sex distribution of weight-for-height categories of 371 children attending PML Children’s Hospital in Accra, Ghana

	Nutritional status		<i>p</i> -value
	Malnourished <i>N</i> = 182 <i>n</i> , %	Well-nourished <i>N</i> = 189 <i>n</i> , %	
Age			
6-9 months	56 (30.8)	55 (29.1)	0.726
10-11 months	38 (20.9)	27 (14.3)	0.095
12-24 months	80 (43.9)	82 (43.4)	0.912
25-59 months	8 (4.4)	25 (13.2)	0.003
Gender			
Male	86 (47.3)	90 (47.6)	0.944
Female	96 (52.7)	99 (52.4)	0.944

There were 122 cases of severe acute malnutrition (SAM) comprising of four (4) cases of marasmic kwashiorkor (oedematous SAM) and 118 cases of marasmus (non-oedematous SAM). A total of 60 cases had moderate acute malnutrition (MAM)

Table 2

Table 3 shows the variety of complementary foods consumed by the children in the study. Home-made maize based foods were the main foods for about half the number of the children assessed. The plain maize gruel constituted the major source of food for a larger fraction of the malnourished children (39.1 %, *n* = 66) while a sizable proportion of the well-nourished children were fed on solid food (38.0 %, *n* = 65) (Table 3). A total of 29.2 % (*n* = 50) of the well-nourished children and 36.7 % (*n* = 62) of the malnourished children were reported to have been fed on fortified maize gruel. A total of 30 children out of the total number of children (*N* = 340) were fed on “Weanimix”, the recommended locally prepared weaning food during the weaning period. The number of well-

Table 2 Factors (feeding practices) associated with malnutrition in children attending PML Children's Hospital in Accra, Ghana

Characteristic		Nutritional status of child		Odds Ratio [95 % CI]	p-value
		Malnourished n, %	Well-nourished n, %		
Problem with feeding child (N = 371)	Yes	95 (52.2)	46 (24.3)	3.39 [2.13-5.42]	<0.001
	No	87 (47.8)	143 (75.7)	1.00	
Child ever been breastfed (N = 371)	No	22 (12.1)	14 (7.4)	1.72 [0.81-3.76]	0.128
	Yes	160 (87.9)	175 (92.6)	1.00	
Difficulties with breastfeeding (N = 362)	Yes	30 (17.3)	34 (18.0)	0.96 [0.54-1.70]	0.871
	No	143 (82.7)	155 (82.0)	1.00	
Breastfeeding status (1st six months) (N = 328)	Mixed	67 (42.9)	52 (30.2)	1.69 [1.01-2.83]	0.034
	Predominant	25 (16.0)	36 (20.9)	0.91 [0.47-1.74]	0.764
	Exclusive	64 (41.1)	84 (48.2)	1.00	
Early initiation of breastfeeding (N = 298)	<1 h	93 (66.4)	106 (67.1)	0.97 [0.58-1.62]	0.904
	≥1 h	47 (33.6)	52 (32.9)	1.00	
Age of addition of complementary food (N = 351)	<6 months	58 (33.7)	38 (21.2)	1.89 [1.14-3.14]	0.009
	≥6 months	114 (66.3)	141 (78.8)	1.00	
Child was fed only formula food from birth (N = 354) Yes	Yes	15 (8.9)	11 (5.9)	1.54 [0.64-3.82]	0.291
	No	154 (91.1)	174 (94.1)	1.00	
Child was bottle-fed (N = 352)	Yes	28 (16.3)	10 (5.6)	3.31 [1.49-7.87]	0.001
	No	144 (83.7)	170 (94.4)	1.00	
Duration of breastfeeding (N = 87)	<6 months	14 (31.8)	6 (14.0)	2.88 [0.89-10.18]	0.048
	≥6 months	30 (68.2)	37 (86.0)	1.00	
Frequency of egg eating (N = 183) ¹	Never or occasional	75 (90.4)	82 (82.0)	2.06 [0.79-5.78]	0.107
	≥1× a week	8 (9.6)	18 (18.0)	1.00	
Frequency of meat/fish eating (N = 173) ¹	Occasional (not everyday)	44 (57.9)	45 (46.4)	1.59 [0.83-3.05]	0.133
	Every day	32 (42.1)	52 (53.6)	1.00	
Frequency of fruit eating (N = 179) ¹	Occasional (not everyday)	57 (70.4)	52 (53.1)	2.10 [1.08-4.11]	0.018
	Every day	24 (29.6)	46 (46.9)	1.00	

¹Only children between the ages of 12 months and 59 months were included in the sampling; CI = Confidence interval

nourished children that fed on Cerelac® was almost twice the number of malnourished children who were fed with Cerelac® as a major weaning food (24.0 % and 14.2 % respectively) (Table 3). A small proportion of the malnourished and well-nourished children (2.4 % and 1.8 %, respectively) were weaned with “iced kenkey”, a fermented cooked maize meal which is mashed, diluted with water and has sugar added to it. The types of solids include common staple foods as some respondents specified the foods they ate while others were more general.

Table 3

Figure 1 depicts the reasons why mothers stopped breastfeeding their children. The main reasons given by the

mothers of malnourished children were the child's refusal to take the breast milk (38.2 %, n = 21) and maternal death/desertion (20.0 %, n = 11) (Fig. 1). Majority of the mothers of well-nourished children gave no satisfactory reason (mostly no response) for stopping breastfeeding, (52.3 %, n = 34) (Fig. 1). The other common reasons mothers of well-nourished children gave for stopping breastfeeding were, the child's refusal (12.3 %, n = 8), being mature enough to stop (12.3 %, n = 8) and work pressure (10.8 %, n = 7) (Fig. 1).

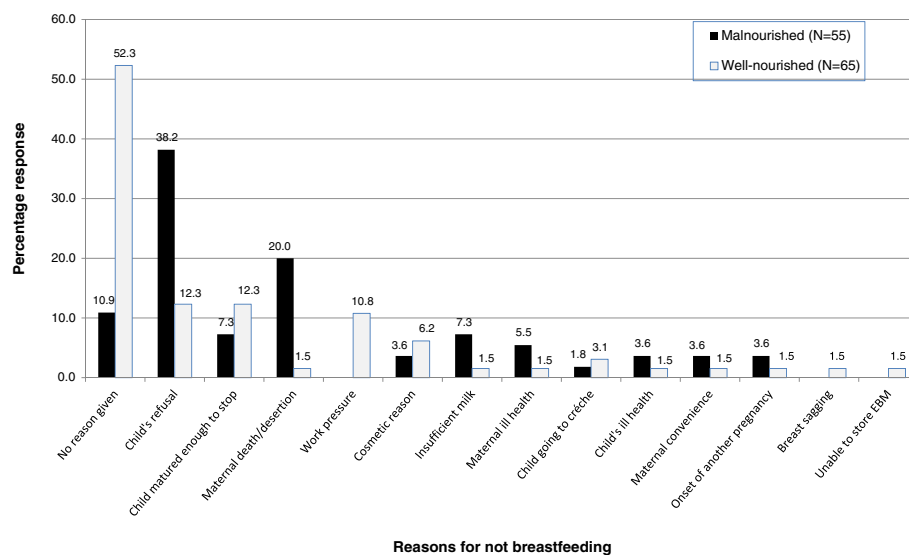
Figure 1

In another set of analysis, the most common duration of breastfeeding was 13–24 months for both groups of

Table 3 Major weaning foods eaten by malnourished and well-nourished children attending PML Children's Hospital in Accra, Ghana

Type of weaning food	Nutritional status of child			Food composition per 100 g				
	Malnourished N = 169 n, % ¹	Well-nourished N = 171 n, % ¹	p-value	Water (g)	Energy (kcal)	Protein (g)	Iron (mg)	Vitamin A ² (IU)
Maize gruel with sugar	66 (39.1)	43 (25.1)	0.006	90.50	37.89	0.57	0.58	NA
Maize gruel with sugar and milk	62 (36.7)	50 (29.2)	0.144	88.19	51.35	1.44	0.52	12.73
Solids	30 (17.8)	65 (38.0)	<0.001					
Rice with tomato stew				71.00	116.88	2.06	0.59	20.00
"Banku" with okro stew				78.20	86.67	2.23	3.67	NA
"Fufu" with palmnut soup				70.00	263.70	1.95	2.47	380.00
Beans with palmoil, cassava grit and plantain				50.11	226.15	3.87	1.39	418.63
Yam with "kontomire" stew				70.00	129.63	2.12	0.65	369.14
Cerelac® (dry mixture)	24 (14.2)	41 (24.0)	0.022	2.50	411.00	15.50	7.50	309.00
Weanimix ("Tom Brown"-dry mixture)	16 (9.5)	14 (8.2)	0.677	7.30	374.00	9.10	7.40	NA
"Mpotompoto"	7 (4.1)	13 (7.6)	0.175	78.50	97.14	0.82	1.06	146.90
Beverage	3 (1.8)	8 (4.7)	0.130					
Milo®				87.00	29.17	1.34	0.77	13.00
Orange juice				86.20	53.00	0.20	0.11	NA
Soy milk				89.40	40.00	2.80	0.40	NA
"Iced kenkey"	4 (2.4)	3 (1.8)	0.691	87.50	48.91	1.23	0.96	9.35

¹Percentages may add up to >100 since multiple answers apply; ²Retinol equivalent; NA = values not available; Weanimix ("Tom Brown") = cereal/legume blend; "Mpotompoto" = traditional food prepared from tubers such as yam, cocoyam or potatoes with vegetables, fish and palm-oil; Beverage = Chocolate drink, soy milk or fruit juice; "Iced kenkey" = fermented cooked maize meal which is mashed, diluted with water and has sugar added to it; "Fufu" = Pounded yam, cocoyam, plantain and/or cassava; "Banku" = cooked maize ball made of fermented maize powder; "Kontomire" = a stew of cocoyam leaves in palm-oil base tomato sauce resembling spinach stew; Reference values were from Microdiet version 3.1 [41], Eysen and Ankrah, 1975 [42] and ESHA [43]

**Fig. 1** Reasons given by mothers for stopping breastfeeding their children. (EBM = Expressed breast milk)

study participants (43.2 % in the malnourished group and 69.8 % in the well-nourished group). However, breastfeeding duration of 6 months or less was more commonly reported by mothers of malnourished children (36.4 %) as compared with well-nourished children (14.0 %) (Data not shown).

Discussion

This study differs from Dr William's study of Kwashiorkor in 1933 in some respects [1]. A majority of the malnourished children in this study, 118 out of 182 had marasmus while those she studied mainly had kwashiorkor. The children studied were also younger than the ones she studied. More than half of the children in this study were less than 1 year old, while her study involved children between the ages of 1 and 4 years. This is probably related to her focus on Kwashiorkor which tends to occur in older children. However, it may also be related to the greater contribution of a shorter duration of breastfeeding and problems with complementary feeding to the current aetiology of malnutrition.

Dr Williams reported at the time that the mothers were feeding their children with a plain fermented maize diet made up of a porridge "arkasa" or cooked maize meal mashed in water with added sugar "iced kenkey" [1]. It is rewarding to note that "iced kenkey" which was reported as one of the popular weaning foods during Dr William's time is no longer a popular weaning food. It is also rewarding to note that a sizable proportion of both mothers of malnourished (36.7 %) and well-nourished (29.2 %) children reported that they also gave their children maize porridge that had been fortified [10].

In contrast, it is disheartening to note that a greater proportion of the malnourished (38.1 %) and a quarter (25.1 %) of well-nourished children were still being weaned with plain "arkasa" the unfortified fermented maize porridge Dr Williams wrote about [1]. The popularity of this plain unfortified maize gruel among these mothers is probably because it is readily available, affordable, easy to prepare and store though it requires some cooking. In addition, the cooked form is sold by street-vendors making it easily accessible. Unfortunately, such diets have been described as providing suboptimal nutrition and have low energy density with high water and anti-nutrient content [7, 10, 24, 25].

It is not clear whether mothers who did not fortify their porridge were unaware of the recommendation or were unable to afford the products for fortifying the porridge. Thus, effective nutritional education as well as easy access to the foods for fortifying the gruel is needed to prevent the continuation of this practice. To this end, the new teaching module by the Food and Agriculture Organization (FAO) on nutritional

counselling may offer a better approach to conveying educational messages [26].

Other faulty feeding practices of malnourished children identified during the study were early weaning, shorter duration of breastfeeding, mixed feeding and lack of exclusive breastfeeding and fruits in the diet. These findings are similar to the study at PML in the 1990's which found suboptimal breastfeeding to be associated with malnutrition [2]. It is also similar to a study from Ethiopia which showed that Severe Acute Malnutrition was associated with inappropriate feeding practices including supplementation with pre-lactal feeds, lack of exclusive breast feeding in the first 6 months, late initiation of complementary diet at 12 months and beyond and bottle feeding [4]. The findings are further supported by a study in Tanzania, which found that most stunted children were not exclusively breast fed for the first 6 months and a study in Brazil, which found that early weaning, use of commercial cereals and formula for weaning among mothers were associated with malnutrition [5, 6].

Exclusive breastfeeding rates in Ghana fell from 63.7 % in 2008 to 46 % in 2011 [13, 27]. In this study, exclusive breastfeeding was reported by 41 % of mothers of malnourished children and 48 % of the mothers of well-nourished children. Possible reasons for the fall in breastfeeding are many ranging from misconceptions about exclusive breastfeeding to lack of institutional capacity to sustain public education on breastfeeding particularly in communities [28, 29]. We found that one of the reasons for stopping breastfeeding in malnourished children was maternal death or desertion, Dr Williams had also observed that malnutrition in children who were being fostered, emphasising the importance of social care and clear guidelines for feeding infants in special circumstances. The most common reason however was the child's refusal to suck the breast in contrast with Dr Williams finding that the children with Kwashiorkor were "deposed" or stopped from breastfeeding. This may be due to "nursing strike" which is a sudden refusal to breastfeed and can occur at any time during the breastfeeding process leading to complete weaning [30]. It may be temporary or permanent [31].

Nursing strike has been linked to several factors including mothers' menses, a change in the mothers' diet, soap, deodorant, teething or illness in the infant, playful infant, nasal obstruction, vaccination area pain, breast and labour problems [30–32]. In this study, a child's refusal to breastfeed was reported by 38.2 % of mothers of malnourished children. A study of 500 breastfeeding mothers in Mauritius found that reluctance to suckle was a minor problem occurring in only 4.1 % of the mothers [33]. However, researchers from Teheran found a high frequency of nursing strike in 41 out of 177

(24 %) 6 month olds attending a child welfare clinic [32]. A recent study in Nigeria also found that nursing strike or refusal to suck was present in 2.8 % of the 421 mothers who had nursed at least one child for 12 months or more [31]. The most common reasons the mothers gave for this occurrence were the introduction of formula feed and or non-milk based feed just prior to onset of the strike; others were, inadequate milk flow, illness in infant and teething.

Feeding problems have been defined as the inability or refusal of children to eat certain foods [22]. They include medical, oral and behavioural disorders some of which are complex conditions [22, 34, 35]. Comprehensive assessment of these problems requires both a clinical evaluation and a parental report and may involve the use of parental questionnaires and multidisciplinary team assessment [22, 34]. In this study, feeding problems were reported in twice as many malnourished children (52.2 %) as compared to well-nourished children (23.5 %). This was based on parental report obtained from an exploratory question and although this approach is recommended, it may over or under estimate the frequency of feeding problems [22]. It is also not clear whether the refusal to feed was related to anorexia due to malnutrition or ill health which might have influenced the decision to wean breastfeeding children early as has been reported by a similar study in Ghana [36]. Given these findings, it will be expedient to carry out more detailed studies to evaluate feeding problems and nursing strike in malnourished children since majority of the factors causing these conditions are amenable to treatment [30, 34].

In this study, the odds of a being malnourished in children aged 12 to 59 months were twice if the frequency of that child's fruit intake was occasional compared with a child whose fruit intake was everyday. This partly supports the evidence that the diet of children living in communities where malnutrition is prevalent usually consists of mainly cereals and tubers and have limited fruit and diversity in vegetable as well as animal sources of nutrients [7, 25].

We found no association between consumption of animal products and malnutrition. This is interesting because it is generally thought that malnourished children have a diet that is lacking in animal products. It is possible that the consumption of animal products by the malnourished children was frequent but the proportions were inadequate and this was not captured by the analysis.

Our findings show that Weanimix was not well patronised by both groups of mothers. The level of use of weanimix as a main complementary food by mothers in this study is rather low and disappointing. This requires further study for explanations as it may have

affected the assessment of its association with malnutrition. However it is similar to findings from a survey in Korle Gonno, Accra, which showed that most mothers preferred commercially prepared alternatives even in the more deprived parts of the community [37]. Since the question asked for the main complementary feeding diet, it may well be that the mothers did not consider it the main complementary food but rather used it in addition to others hence the low reportage. It could also be due to wrong classification of Weanimix as fortified maize gruel. It takes time to prepare Weanimix from scratch and some mothers may lack the time to prepare it or resources to buy already packaged powders of the blend and turn to cheaper alternatives. A study in Ghana indicated that indeed some mothers did find the pre-packaged ones expensive but preferred to make their own homemade versions that is why a more focussed study of the the use of Weanimix and malnutrition is needed [36].

The constraints of urbanization make buying cooked plain fermented maize porridge more convenient and cheaper for some mothers rather than to cook foods like weanimix at home, particularly since weanimix is not sold in cooked form. In the same way, the ease of preparation may explain the patronage of Cerelac[®], in spite of its expense as it does not require cooking. A study in Accra has shown that Cerelac[®] was rated very high in providing health, child acceptance, convenience and ease of acquisition but expensive [38]. We also noted the relatively low patronage of the traditional diet "Mpotomoto" which used to be a popular weaning food but requires substantial cooking.

These findings seem to suggest that this generation of mothers are looking for affordable, accessible, and easy to prepare weaning foods and unless new local complementary foods are developed which are wholesome and yet have these qualities, it will be difficult to wean them off the old faulty but convenient practices. Consequently, interventions to prevent malnutrition should include introducing technology for developing new weaning diets from locally available foods with attention to marketing and consumer preferences as nutrition education alone cannot improve complementary feeding when there is food insecurity [39, 40]. So although significant strides have been made in understanding the aetiology of malnutrition and improving its management since the days of Dr Williams, the challenge of preventing the condition by promoting optimal feeding practices remains [25].

There were some limitations during the conduct of this study. It was not possible to obtain responses to all the questions asked and there were some missing data. We included only a few cases of kwashiorkor partly because some children with kwashiorkor could not stand

for height measurements and were not well enough for inclusion as stipulated by the inclusion criteria. In addition there has been a general decline in the number of cases of Kwashiorkor [14]. Children in the well-nourished category may include some mildly malnourished children from previous classification. This classification has been used to allow for comparison with current literature and is also due to the difficulty in recruiting sufficient well-nourished children within the period of the study from this setting. There may have been some confusion with the classification of weanimix.

Conclusion

The weaning diet in children attending PML Children's Hospital in Accra, Ghana, has changed since the time of Dr Cecily Williams. "Iced kenkey", a fermented maize diet, is no longer prominent as a weaning food, compared to the 1930's. However, the use of the plain fermented maize porridge associated with malnutrition is still popular among mothers of malnourished children. The study highlights the need to use more effective methods to transmit nutrition education messages to achieve behaviour change. It also highlights the popularity of complementary foods that are easy to prepare and the need to study the changing preferences of mothers in order to develop new diets that are wholesome and yet appeal to a new generation of mothers. Further studies are also needed to obtain a better understanding of the pathophysiology of feeding problems in malnourished children, the barriers to breastfeeding and the patronage of Weanimix, the recommended cereal/legume blend.

Abbreviations

MAM, Moderate acute malnutrition; MUAC, Mid-upper arm circumference; ORS, Oral rehydration salt; PML, Princess Marie Louise Children's Hospital; SAM, Severe acute malnutrition

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Availability of data and materials

The data from this study is available. However it belongs to a third party, the University of Ghana since this research was carried out under the auspices of the University and sponsored by its Office of Research Innovation and Development (ORID). According to the University's Research Policy, permission is required from the University before the data can be shared. Thus requests for the data should be directed to:
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Authors' contribution

The authors EMAT, ETN and EKS worked on the conception, study design, and the final article composition. EMAT, ETN, EKS and PT-D contributed to the methods, results, and the articles' continuous critical review. ETN, EMAT and PN-A worked critically on the data analysis. ETN, EMAT, PT-D and PN-A worked on the interpretation of data, discussion and revision of the article. All the authors read and approved the final article.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

Ethical clearance was obtained from the Ghana Health Service Ethical Review Committee [Protocol ID No.: GHS-ERC 126 05/07/2012]. Ethical clearance was also obtained from the University of Ghana Medical School's Ethical and Protocol Review Committee [Protocol Identification Number: MS-Et/M.8-P.5.8/2011-2012]. Formal consent was obtained from parents/carers of the children using consent forms which were signed or thumb printed before administering the questionnaires.

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