

Interventions for the control of diarrhoeal diseases among young children: weaning education*

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A review of data from 12 developing countries suggests that it is possible, even in poor communities, to improve substantially the nutritional status of infants and young children by weaning education. Face-to-face communication by locally recruited workers, reinforced by radio and other mass media, may be the most effective channels for weaning education. It is estimated that, through its effect on nutritional status, weaning education may reduce the diarrhoea mortality rate among children under 5 years of age by 2-12%. The possible impacts of weaning education on food hygiene and on feeding during and after diarrhoeal illness are not considered in this paper. Preliminary estimates of cost-effectiveness suggest that weaning education may be an economically attractive intervention for reducing diarrhoea mortality in some countries. Several important aspects of weaning education and its relation to diarrhoea need to be clarified by research.

This review is one of a series in which potential interventions for the control of diarrhoeal diseases are being examined (29). In an earlier review, data were presented showing that poor nutritional status predisposes to more severe and longer-lasting diarrhoea and to higher case fatality rates (25). It might reasonably be expected, therefore, that a reduction in the prevalence of malnutrition in young children will reduce diarrhoea mortality rates. Food scarcity is one of many causes of malnutrition and a possible intervention to reduce the prevalence of malnutrition is the planned distribution of food-stuffs. This potential intervention has been examined (25), and it was found that routine supplementary feeding programmes have been largely ineffective in reducing the prevalence of malnutrition in children under 24 months of age, who suffer the highest diarrhoea morbidity and mortality rates. It was considered unlikely that supplementary feeding programmes would be a cost-effective intervention in national diarrhoea-control programmes, and it was suggested that attention might be better directed towards improving weaning practices.

Food scarcity is usually not a major cause of malnutrition in young children except in extreme poverty or during war or famine, whereas faulty

weaning practices can be identified in most communities. These practices include (1) using foods of low energy and nutrient concentration, (2) selecting single foods of low nutritional value, (3) using contaminated foods, (4) feeding at infrequent intervals, (5) introducing weaning foods too early or too late, (6) weaning abruptly, and (7) giving a disproportionately small share of the family food. In this review, the tenth of the series (3, 21, 22, 24-28),^a we examine whether weaning education can modify weaning practices in unfavourable environments and improve the nutritional status of young children, thereby reducing diarrhoea morbidity, mortality or severity. The promotion of appropriate feeding during and after diarrhoeal illness is not considered in this paper, although it may well be an effective intervention and will usually be included within any weaning education programme.

EFFECTIVENESS

For weaning education to be an effective intervention to control diarrhoea, it must be true that

either

impaired nutritional status predisposes young children to increased diarrhoea morbidity, or mortality or severity

hypothesis
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and

weaning education can modify weaning practices and thereby improve the nutritional status of young children

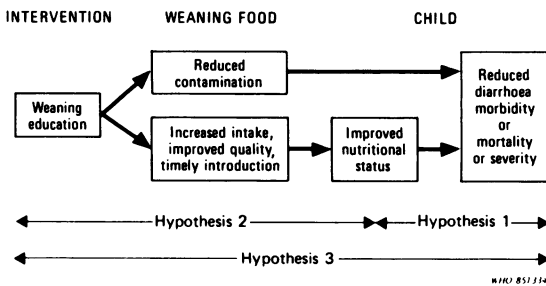
hypothesis 2

or

weaning education can reduce diarrhoea morbidity, mortality or severity in young children

hypothesis 3

The potential effectiveness of improving weaning practices would be suggested by a demonstration either of the correctness of hypotheses 1 and 2 or of the correctness of hypothesis 3. This is schematically represented in the Figure.



In this review we concentrate on the link between weaning practices and diarrhoea via nutritional status. The more direct link via pathogen ingestion due to the contamination of weaning foods will be considered separately in a review of food hygiene (in preparation). The evidence for and against these three hypotheses, excluding the link through reduced contamination, is examined below.

Hypothesis 1. Impaired nutritional status predisposes young children to increased diarrhoea morbidity, or mortality or severity.

This hypothesis was considered in the second review of this series in relation to supplementary feeding programmes (25). It was concluded that there was little evidence that poor nutritional status predisposes to increased diarrhoeal disease incidence rates, but good evidence that it predisposes to increased severity and duration of diarrhoea attacks and to increased risk of diarrhoea mortality. Recently published data from Bangladesh confirm that poor nutritional status is associated with increased duration of diarrhoea, but not with increased incidence rates (9).

Hypothesis 2. Weaning education can modify weaning practices and thereby improve the nutritional status of young children.

There is considerable evidence that energy and nutrient intakes during weaning are frequently inadequate in developing countries. There are several factors which give rise to inadequate intakes. Some factors are commonplace throughout the developing world. These include the use of foods of low energy and nutrient concentration, infrequent feeding, and anorexia associated with infection. Other factors, such as abrupt weaning, delayed introduction of weaning foods, and intrafamilial food-sharing in favour of male members, are culture-specific (14, 15). Studies in several countries have quantified the marked impact that these factors can exert on dietary adequacy (11, 13, 14, 42, 43, 49, 50, 56).

Because adverse weaning practices are so widespread, weaning education is a popular component of international and national programmes not only in relation to health, but also in relation to agriculture and community development. Furthermore, compared with many other interventions, weaning education may be relatively inexpensive. Little is known, however, about the effectiveness of nutrition education. The Eighth Report of the Joint FAO/WHO Expert Committee on Nutrition stated "there is surprisingly little evidence that existing techniques of nutritional education are effective or represent a good utilization of limited resources, and it appears that some conventional programmes of nutritional education have not succeeded in influencing food habits in the desired manner" (60).

In some instances, failure to change dietary habits could be predicted since the nutrition messages have been inappropriate to the economic and social conditions, and cultural patterns, of the target group. For example, caregivers cannot improve their weaning practices if the changes demand resources which they lack, whether it be food, fuel, utensils or time. Neither will mothers change their practices if entrenched cultural beliefs are contravened, as for example beliefs about "hot" and "cold" foods. A second problem is that nutrition educators have tended to give too much information. Education about different nutrients and their functions, and about the principles of a balanced diet, is not readily understood by most audiences in developing countries. For example, in a group of mothers attending nutrition education classes in the Ivory Coast, 86% were unable to classify foods into 3 different groups as they had been taught (1). Grave doubts must therefore also exist concerning the usefulness of the commonly used classifications involving 4, 5 or even 7 food groups. A third problem

is that the location may not be conducive to learning. Clinic attenders, being a captive audience, are a prime target for nutrition educators. Difficulties in attention may arise whether instruction is given during the waiting-time before a clinic or afterwards, since mothers may be anxious not to miss their turn, or anxious to return home. In either case they may not be receptive to the education given. A fourth problem is that different or even conflicting messages may be given by different workers. This is particularly likely when several agencies are involved in nutrition education. Fifthly, nutrition education is often conducted in a perfunctory or ritualistic manner. These problems, either singly or in combination, may explain the apparent lack of success of some nutrition education programmes (46).

In the few instances where nutrition education has been evaluated, the criteria chosen have usually been either an improvement in nutrition knowledge or a change in attitude. Neither of these, however, necessarily leads to a change in behaviour. In the Philippines, radio messages were used to improve weaning practices and a 12-month exposure to these broadcasts changed the attitudes of mothers towards the use of oil, vegetables and fish as weaning foods. Although the three foods were considered a good idea by 74%, 82% and 81% of mothers respectively, only 24%, 17% and 27% were actually using these foods (18). These data illustrate the extent to which attitude and practice may differ, at least in the short term. Evaluations based on a change in knowledge or attitude may therefore not give a true picture of behavioural change and have consequently been omitted from this review. A more meaningful criterion of effectiveness, and one which is in keeping with the hypothesis under discussion, is an improvement in nutritional status. Few weaning education programmes have been evaluated from this perspective. Those for which data are available are discussed below under three headings—nutrition rehabilitation programmes, supplementary feeding programmes, and community-oriented programmes.

Nutrition rehabilitation programmes. The idea of using the recuperation of malnourished children to teach nutrition to their mothers was proposed by Bengoa in 1955 (6, 7). Many nutrition rehabilitation centres have been established throughout the developing world. The premise is that when parents see for themselves that their children gain weight and are healthier, they will be motivated to change their weaning and feeding practices.

Although education is a stated objective of such centres, in practice education has not been given as much attention as feeding and recuperation (5). In these circumstances any evaluation of the effective-

ness of nutrition rehabilitation centres is likely to underestimate their educational potential. The effectiveness of nutrition rehabilitation centres in educational terms cannot be judged by examining the nutritional status of the children being rehabilitated. The question at issue is whether the changed perceptions of the rehabilitated child's parents have influenced their weaning practices with respect to the younger sibling(s) of that child. Evaluations of the effectiveness of weaning education given at rehabilitation centres have therefore compared the nutritional status of rehabilitated children with that of their younger siblings or have compared the nutritional status of the younger siblings of rehabilitated children with that of the younger siblings of a group of similar control children. Five evaluations of this type have been reported from Haiti, Guatemala and Zaire and are summarized in Table 1. In all cases improvements in the nutritional status of younger siblings were reported, although the improvement in Zaire was slight and in only two studies were these differences shown to be statistically significant.

Several investigators have monitored the nutritional status of participants after discharge from the centre and have demonstrated a continuing improvement (41, 47, 48, 51, 55, 59). This has been interpreted as indicating effective nutrition education but the absence of any comparison group of non-participants in these studies, against which to measure the progress of the rehabilitated children, can lead to erroneous conclusions (4).

Domiciliary rehabilitation of malnourished children can also be used to evaluate the effectiveness of weaning education. Three studies of this kind, in Uganda and India, have been located and are summarized in Table 1. In Uganda, mothers with undernourished children at Mwanamugimu and Luteete clinics were requested to attend a series of education classes. Rehabilitation was undertaken at home, by the child's mother, with little or no food being provided by the clinic (33, 47, 51, 55). Mothers were taught various aspects of food production and preparation, food hygiene, and simple health care. In Palghar, India, malnourished children have likewise been successfully rehabilitated at home without recourse to external sources of food (52). Mothers of 16 children with kwashiorkor were advised to give family foods 4 or 5 times daily, with special emphasis on groundnuts and other legumes, jaggery (a type of sugar), and cheap fish. Mean energy intakes increased from 226 to 494 kJ (54 to 118 kcal)/kg/day and mean protein intakes increased from 2.0 to 4.3 g/kg/day. In Madras City, 53 mothers of undernourished children were taught how to prepare a simple mixture of roasted Bengal gram flour and jaggery (61).

Table 1. The effect of weaning education on nutritional status in three different types of programmes

Programme	Country	Age groups (months)	< 75% weight-for-age		Improvement in nutritional status	Statistical significance of improvement	Reference
			Participants (%)	Controls (%)			
1. Nutrition rehabilitation							
(a) Siblings of participants							
	Haiti		— ^a	—	Yes	$P < 0.01$	59
	(i)		—	—	Yes	—	8
	(ii)		—	—	Yes	NS ^b	4
	(iii)		—	—	Yes	$P \leq 0.05$	4
	Guatemala		—	—	Yes	NS	12
	Zaire	8-24	—	—	Yes	—	33
(b) At home							
	Uganda ^c		—	—	Yes	—	53
	India:						
	(i) Palghar	< 60	24	40	Yes	—	61
	(ii) Madras	6-17	—	—	No	—	61
		18-47	—	—	Yes	—	
2. Supplementary feeding							
	Morocco ^{c,h}	30-59	16	34	Yes	$P < 0.001$	31
	Kenya ^{a,h}	6-59	41	44	Yes	—	34
3. Community-oriented							
	Philippines ^{d,g,h}	1-17	42	64	Yes	$P < 0.001$	38
	India:						
	(i) Karnataka ^f	0-59	—	—	Yes ^j	—	57
	(ii) Punjab ^{f,g,i}	12-35	19	32	Yes	—	19
	Jamaica ^f	0-23	9	10	Yes	NS	2
	Burkina Faso	6-23	12	35	Yes	$P \leq 0.05$	62
	Indonesia ^{f,s}	9-23	15	32	Yes	$P \leq 0.05$	Unpublished ^t
	Thailand ^g	0-59	7	15	Yes	—	58

^a Data not available.

^b NS = $P > 0.05$.

^c Included instruction on health, hygiene and sanitation.

^d Included instruction on home economics.

^e Included instruction on agriculture and breast-feeding promotion.

^f Included instruction on oral rehydration.

^g Included growth monitoring.

^h < 80% weight-for-age.

ⁱ < 70% weight-for-age.

^j Based on maternal reporting only.

^k See footnote c on page 1120.

Mothers attended only a single teaching session. In all three projects there was an overall improvement in the nutritional status of the children, but it is not reported whether the improvements were statistically significant (Table 1), and in Madras City there was no improvement in children in the youngest age group (6-17 months) whose mothers chiefly ignored the advice for fear of diarrhoea.

In Palghar, the impact of weaning education appeared to extend beyond the target family since 85% of the neighbours of the domiciliary group are reported to have modified their feeding practices (53). This is in contrast to experience in Haiti where there was no evidence that the knowledge gained by mothers at the nutrition rehabilitation centre was disseminated to their neighbours (39).

In conclusion, the Ugandan and Indian studies, albeit small-scale, indicate that nutrition education can improve feeding practices, at least in children

aged 18-47 months, even in conditions of poverty. The fact that improved growth was achieved at home, with no input other than education, is noteworthy. A significant improvement in nutritional status has been observed in the siblings of malnourished children admitted to rehabilitation centres in Haiti and Guatemala. Casual observation suggests that the education being given in some rehabilitation centres is inadequate, which may explain the variable impact of weaning education in such centres.

Supplementary feeding programmes. Education is often stressed as an essential component of supplementary feeding programmes. An assessment of the impact of nutrition education in one such programme in Morocco was undertaken by Catholic Relief Services (31) in 1972-75, when a substantial take-home food supplement was provided to indigent families at monthly intervals. From 1975 onwards, an

education component was added so that when mothers collected their monthly rations they also received 20–50 minutes of instruction about nutrition, health, sanitation and personal hygiene. Weaning practices were changed by the education component. In 1978, only 15% of programme participants weaned abruptly in contrast to 91% in 1975, and there was a statistically significant increase in the consumption of milk products and fruits. The education component was found also to have a significant impact on nutritional status (Table 1).

In contrast, the education component of the Catholic Relief Services' supplementary feeding programme in Central Province, Kenya, was considered to have little impact either on the feeding practices of mothers or on the nutritional status of the beneficiaries (Table 1) (34). The difference in impact in the two countries is probably due to the manner in which the education was conducted. In Kenya, teaching assistants with little or no nutrition training had a fixed repertory of lectures on child care, each lasting about 20 minutes. Little individual advice was given and the long waiting-time did not create a favourable atmosphere. Furthermore, the tone of teaching was often brusque and authoritarian. In Morocco, on the other hand, there was a dynamic style of instruction with 79% of mothers making comments, and even mothers who were not enrolled in the programme were observed to join the classes.

Community-oriented programmes. Weaning education has been found to be effective in preventing malnutrition even without the provision of supplementary food. In the Philippines a malnutrition prevention programme was introduced in 1975 by the Bureau of Agriculture Extension (38). In this programme, mothers of infants aged 1–17 months attend classes for 3–4 hours weekly over a one-year period. There they were taught how to prepare a variety of weaning mixtures using locally-grown foods and told to introduce them at 5 months of age or earlier, in order to maintain a satisfactory weight gain. Infants were weighed each month and the mothers also received instruction about various aspects of home economics. An evaluation of this programme found a significant impact on nutritional status (Table 1).

Weaning education is an integral part of the India Population Project in the state of Karnataka, and its effectiveness was tested in 12 villages which had been visited by a mobile education team on six or more occasions during a 5-year period (57). A random sample of 120 women who had attended group talks or cooking demonstrations of weaning foods, and a random sample of 145 non-attenders, were selected. Although supplementation before 6 months of age

was taught, a similar proportion of attenders and non-attenders believed breast milk alone was adequate beyond 6 months of age (75% v. 82%) and only 14% of attenders had introduced semi-solid foods before 6 months of age. Although mothers were reluctant to change their traditional practice regarding 'when' to supplement, they more readily accepted advice as to 'what' supplements to give. Of the mothers who were exposed to weaning education, 44% had actually prepared the weaning food that had been demonstrated (wheat, Bengal gram, groundnuts, green leafy vegetables, and jaggery) and 35% stated that regular feeding of the recipe had improved the health or growth of their child. Of the remaining mothers, poverty was stated to be the main reason for not preparing the recipe at home.

In the Punjab, privileged mothers complied with advice on weaning whereas underprivileged mothers did not (19). The advice, if followed, required additional expenditure of both time and money. When the advice was changed so that underprivileged mothers did not have to alter their usual routine and were shown by locally-recruited workers how to crumble a piece of chapatti into a little sweetened tea, two-thirds of the underprivileged mothers complied. This programme of health and weaning education reduced the prevalence of severe malnutrition by 41% (Table 1).

The Lambs River Project in rural Jamaica sought to evaluate a 'pure' education input and to employ only locally available personnel (2). The aim was to produce a realistic model capable of duplication in other areas. Nutrition was incorporated into the primary school curriculum, increased food production was advocated by the agricultural extension services, and improved breastfeeding practices and weaning practices were taught by local volunteer home-visitors who had received 10–20 hours of training. When the programme was evaluated two years after its inception some changes in attitudes towards weaning were discernible—more mothers in the project area favoured the introduction of solid foods at 3–5 months of age compared with mothers in the control area (31% v. 19%), and more mothers in the project area favoured the use of fish (68% v. 51%) and legumes (68% v. 31%). The project had as its ultimate objective the improved nutritional status of infants and young children. After 2 years of operation this objective had not been achieved (Table 1). Unfortunately two events occurred in the project area which may have adversely affected nutritional status. These were the absence of a public health nurse for 17 months with a consequent fall in clinic attendance, and a severe epidemic of scabies which had a debilitating effect on some children. It is therefore possible that these adverse factors might have masked

any improvement that may have occurred as a result of nutrition education.

The "bottom-up" approach, utilizing local resources, has proved beneficial in Yako, Burkina Faso, where education to promote low-cost, home-made weaning foods has succeeded in preventing a deterioration in nutritional status in a percentage of infants (62). Group lessons and weaning food demonstrations are provided once a month to all mothers in participating villages by weaning food monitors, using the 'echo' method. The volunteer monitors are illiterate mothers from the village who meet with their public health nurse supervisor in a central market village to learn and rehearse the month's lesson, which is structured as a question and answer session. Each monitor then returns home and repeats the lesson and cooking demonstration with her neighbourhood mothers. Monitors also provide weaning education individually. An evaluation demonstrated a significantly lower proportion of malnourished infants in Yako than in Koupele, where weaning education was provided by home economists who were outsiders and from a different social stratum (Table 1).

A further example of community involvement can be found in rural Indonesia. In a pilot project, volunteer village nutrition workers (*kaders*) were specifically trained to give advice on weaning.^b Their advice was reinforced by broadcasting the same messages by radio. The project is a component of the larger Indonesian Nutrition Improvement Program. Before introducing the weaning education component, a self-survey was conducted in 10 villages at which all children were weighed and their weights plotted on a single community graph. Community meetings were then held to allow village leaders and mothers to suggest solutions to the problems identified in the survey and to formulate their own nutrition messages. Data from 330 household interviews were also analysed to determine current weaning practices, and to identify practices which would, or would not, be amenable to change. After numerous trials, a home-prepared weaning food was developed using local ingredients. The trials and recipe modifications were undertaken in the mother's presence in her own home. Inclusion of fat (either as coconut milk or oil) and green vegetables, and feeding 4 meals per day in addition to breast milk were the main educational inputs regarding weaning practices, but advice was also given regarding increased food intakes during pregnancy and lactation, breast-feeding, growth monitoring and the treatment of diarrhoea. The weaning education component was

implemented in 1980 and its impact was evaluated 15 months later^c by comparing the weaning practices in 600 households in the project areas with weaning practices in 400 households in comparison areas where the *kaders* were not acquainted with the nutrition messages. The results show that the education project had a considerable effect not only on the knowledge and attitudes of the mothers, but also on their weaning practices and that these practices favourably influenced the nutritional status of their infants (Table 1).

In the Indonesian project, the radio was used to reinforce face-to-face weaning education. Repetition of carefully designed and pre-tested messages provided consistent and sound nutrition advice that was feasible and culturally relevant. In Iloilo in the Philippines, radio messages alone changed the weaning practices of some mothers within 6 months (18, 63). On evaluation, after controlling for a variety of socioeconomic variables, a significant correlation was found between maternal nutrition knowledge and the nutritional status of infants aged 6-15 months.

In Thailand, the Nutrition Division of the Ministry of Public Health in conjunction with USAID undertook a study from October 1980 to March 1981 to test whether the nutritional status of pre-school children could be improved by a combination of nutrition education and growth monitoring, the premise being that keeping growth charts would motivate mothers to improve their feeding practices (58). During the 6-month period, the proportion of children weighing <75% of the Thai standard decreased by 17% in the control villages, 22% in the villages with growth charts, and 59% in the villages with both education and growth charts (Table 1). The impact of education was more pronounced in the village where the village health volunteers and village health communicators went to the home (75% reduction) than in the villages where mothers and children came to a central location (41% reduction).

Conclusions on hypothesis 2. Although none of the evaluations of the effectiveness of weaning education is unflawed, the results summarized in Table 1 nevertheless strongly suggest that it is possible, even in poor communities, to improve the nutritional status of infants and young children by weaning education. In general, the 'bottom-up' approach, which aims at community self-care, appears to have been successful, in contrast to 'conventional' nutrition education methods. Face-to-face communication by locally-recruited workers reinforced by radio messages may

^b MANOFF INTERNATIONAL INC. *Nutritional education and behavior change component. Indonesian Nutrition Improvement Program.* Manoff International Inc., New York, NY 10017, USA.

^c ZEITLIN, M. F. ET AL. *Indonesian Nutrition Development Program. Volume IV: Household evaluation. Nutrition communication and behavior change component.* Report by Manoff International Inc. to Department of Health, Republic of Indonesia, June 1984.

be the most effective channels. Where weaning education programmes have improved nutritional status, great care has been taken to work closely with the target group to identify specific weaning problems and then to formulate specific remedial measures which are thoroughly pretested and redesigned as necessary. Growth monitoring is an integral part of most of the successful community-oriented weaning education programmes. Whether the programmes would be as successful without a visual record of the child's growth is not known. Weaning education has to provide practical answers to specific problems. This will involve prior research among the target group to determine (1) nutritional status according to season, age and sex, (2) current weaning practices and food beliefs, (3) resources available within the family and within the community, and (4) the potential channels for communication.

Hypothesis 3. *Weaning education can reduce diarrhoea morbidity, or mortality, or severity in young children.*

No studies of diarrhoea rates in children whose mothers have received weaning education have been located. It is possible, however, to use data presented above to make speculative predictions of the impact on diarrhoea rates that might accompany a successful weaning education programme.

The diagram at the beginning of this paper shows that weaning education may act on diarrhoea through improved nutritional status and through reduced food contamination. Only the first of these pathways is considered here; the effect of reduced food contamination is being reviewed in a separate paper in this series. The speculative impacts of weaning education computed below are those achieved through improved nutritional status alone, and therefore may underestimate the true impact of weaning education.

As discussed under hypothesis 1, the weight of evidence suggests that improved nutritional status predisposes to reduced diarrhoea severity and reduced diarrhoea mortality rates, but not to reduced incidence rates. Thus it will be assumed that there is no impact of weaning education on diarrhoea morbidity rates via improved nutritional status, although there may well be an impact due to reduced food contamination.

Black et al. (9) have shown that, among children aged <24 months in Bangladesh, diarrhoea duration increases progressively as nutritional status decreases. This effect is apparent for moderately malnourished children (60–74% weight-for-age) as well as for severely malnourished children (<60% weight-for-age). Other data from Bangladesh (16) show that

children aged 13–23 months who were followed over 2 years had a 1.7 times higher mortality rate from all causes if they were <75% weight-for-age than if they were $\geq 75\%$ weight-for-age. These same children had a 3.7 times higher diarrhoea mortality rate if they were <65% weight-for-age than if they were $\geq 65\%$ weight-for-age. Combining these pieces of evidence, it is reasonable to assume that children who are moderately or severely malnourished (<75% weight-for-age) have a diarrhoea mortality rate twice as high as other children.

The studies summarized in Table 1 suggest that a weaning education programme can halve the proportion of children who are <75% weight-for-age. Based on this impact figure it is possible to compute the percentage reductions in diarrhoea mortality rate among children under 5 years of age that would be expected as a result of a weaning education programme in communities having different levels of moderate and severe malnutrition (Table 2). For these computations it is necessary to make assumptions about the age groups for which the prevalence of moderate and severe malnutrition is halved. The effect of weaning education cannot be expected before the age of initiation of weaning. This age varies greatly in different societies, but 6 months is the age recommended in many breastfeeding and weaning education programmes. The upper age limit is more

Table 2. Estimated reductions in diarrhoea mortality rates among children under 5 years of age due to weaning education programmes that halve the prevalence of moderate and severe malnutrition in communities with differing levels of malnutrition

Percentage of children <75% weight-for-age	Percentage reduction in diarrhoea mortality rate among children under 5 years of age caused by weaning education ^a		
	Conservative assumptions ^b	Optimistic assumptions ^c	
Before weaning education			
After weaning education			
10	5	2	3
20	10	4	6
30	15	6	8
40	20	7	10
50	25	8	12

^a Assuming that children <75% weight-for-age have a 2 times higher diarrhoea mortality rate than other children (see text).

^b Assuming that 47% of diarrhoea deaths in children under 5 years occur in children aged 6–23 months (22), and that the effect of weaning education on nutritional status is only in children aged 6–23 months (see text).

^c Assuming that 74% of diarrhoea deaths in the children under 5 years occur in children aged 6–59 months (22), and that the effect of weaning education on nutritional status is in children aged 6–59 months (see text).

difficult to estimate. If the effect of weaning education is only manifest during the weaning period, then 18 months or 24 months might represent the upper limit. However, a high proportion of under-nutrition in the age group 24–59 months may be due to failure of catch-up following the weaning period. In this case, weaning education may have an effect on the prevalence of malnutrition up till 5 years of age. It will be assumed, therefore, that the prevalence of moderate and severe malnutrition is halved from 6 months of age until either 23 months or 59 months, representing conservative and optimistic assumptions. Reductions in diarrhoea mortality rates of 2–12% are derived (Table 2). As previously stated, these estimated mortality reductions exclude any effects of weaning education on food hygiene and any consequent reductions in both morbidity and mortality rates.

FEASIBILITY

Weaning education programmes have been successfully carried out in several developing countries. There have also been failures. Frequently the advice given is too complex, inappropriate, and impractical. In Uganda, the simpler recommendations were followed by a majority of women attending the Mwanamugimu rehabilitation centre, but innovations requiring expenditure of both money and time, such as building chicken runs and keeping rabbits, were largely disregarded (33). Likewise in Transkei, South Africa, the costs of fencing and seeds prevented the establishment of vegetable plots which were being promoted as part of a nutrition rehabilitation programme (30). In Uganda, weaning education was considered a difficult task in urban areas since the resources of families without land were limited (33). In urban rehabilitation centres in Haiti, maternal participation was difficult to achieve, partly because of greater mobility and partly because of maternal employment (40).

There are social, economic and environmental factors which will influence the feasibility of programmes to improve weaning practices. Feeding a weaning child is time-consuming and requires considerable patience. Where mothers are required to work long hours, fetch water and firewood, or pound grain, it is difficult to find the time to prepare special foods or to feed a child frequently. Competing demands on a mother's time, and the resources available to her, will influence whether improving weaning practices is a feasible intervention. It is possible that a certain minimum level of basic resources, particularly water and fuel, need to be

available before attempting to improve weaning practices.

The low energy and nutrient concentration of traditional weaning foods is a widespread problem. One possible solution is to incorporate additional foods of high nutritional value (17, 20). This may not be feasible, however, for families with a marginal income. An alternative is to modify the staple food itself, either by malting (10, 44) or by extrusion cooking (37).^d The former is often carried out in the home for the purpose of brewing alcoholic beverages but it is rarely made use of in relation to improving weaning diets. Extrusion cooking is more applicable to the production of weaning foods at the village level. The effect of both malting and extrusion cooking is to alter the water-binding properties of the starch molecule so that for a given viscosity more of the staple can be incorporated, thus increasing its concentration. Malting is more effective in altering viscosity than extrusion cooking because malting produces amylases which disrupt the starch molecule more completely. Because of its potential, research is needed to assess the feasibility of malting as a means of improving weaning diets.

Extruded weaning foods have been produced in several developing countries (35, 36). The product is partially cooked and the process permits the blending of cereals with legumes and oilseeds. Processing costs (1982 prices) based on experience in Sri Lanka and the United Republic of Tanzania are less than US\$ 0.06/kg and, although higher costs of US\$ 0.24/kg have been reported from Guyana,^e it is possible that extruded weaning foods could be retailed at relatively low cost in some countries. This might be a feasible alternative for the busy working mother with a small income who is unable to find the time to prepare special weaning mixtures.

Collective production of weaning foods at the village level has been suggested as having a dual advantage of reaching everyone in the target group and of lightening the daily responsibilities of women (23). In some countries, such cooperative enterprises already exist (32).

Industrially prepared weaning foods are more expensive than staple commodities but there are advantages in terms of convenience, improved quality, and improved energy and nutrient concentration. Production, packaging, and distribution costs are generally more than twice the cost of the raw ingredients (32). Distribution costs are greater in rural areas. Experience in several developing

^d Extrusion is a procedure in which food is forced through an orifice. Heat is generated and the food is partially cooked.

^e CARIBBEAN FOOD AND NUTRITION INSTITUTE. *Feeding the weaning age group in the Caribbean*. Proceedings of a Technical Group Meeting, 23–27 Oct. 1978, Georgetown (CFNI-J-26-79).

countries, however, indicates that industrially-prepared weaning foods do not reach the low-income groups (45).

The appropriate timing for introducing weaning foods to the diet of breast-fed infants cannot be precisely defined because the breast-milk yields of mothers and the nutritional requirements of infants vary from one individual to another. In general, however, it is recommended that additional foods should not be introduced before 4 months nor delayed beyond 6 months of age (56). In many developing countries the traditional practice is to introduce additional food considerably earlier than 4 months. In Indonesia, where one of the main nutrition messages was to breast-feed exclusively for 4 months, 42% of mothers ignored this advice.^f In the Indian subcontinent, the reverse situation prevails and the traditional practice is to introduce weaning foods considerably later than 6 months of age. In the Karnataka project, mothers more readily accepted advice on *what* foods to give rather than *when* to give them (57). These Indian and Indonesian examples suggest that it may not be easy to change traditional practices in relation to the age when weaning foods are first introduced. One must remember, however, that there are usually good reasons for a mother's behaviour, as was clearly illustrated in the Punjab where underprivileged mothers failed to comply initially, but did comply later when the advice was changed (19). In view of the discordance between the

current recommendations for the timely introduction of weaning foods and traditional feeding practices, there is a need for more research to improve our understanding of the factors that may influence a mother in deciding when to introduce weaning foods.

COSTS

Cost data on six weaning education programmes are presented in Table 3. These costs are not strictly comparable because of the widely differing programme designs and the differing costing methods and assumptions adopted. Each of the programmes provided face-to-face communication. Costs were lower in Indonesia, Morocco, and Burkina Faso because unpaid volunteers were used.

From the data in Tables 2 and 3, cost-effectiveness estimates of weaning education as a method for reducing diarrhoea mortality may be derived. The following assumptions are made:

- that both malnourished and well-nourished children participate and that the target age group is 6–23 months;
- that the annual cost of the programme is US\$ 5.00 (1982 prices) per participating child (Table 3);
- that a 10% reduction in diarrhoea mortality rate over the first five years of life is achieved among participating children (Table 2);
- that the pre-intervention diarrhoea mortality rate

^f See footnote c on page 1120.

Table 3. Annual costs of weaning education in six countries^a

Country	Annual cost (1982 US\$) ^b		Costs included	Reference
	Per participating child	Per case of malnutrition averted		
Ghana	3.80		Combined costs of community health programme and education by clinic staff	64
Haiti	16.60		Training and administrative costs of rehabilitation centre	40
Indonesia	2.00	12.00	Total programme costs, excluding technical assistance	Unpublished ^c
Morocco	4.20		Training and local administration	31
Philippines	9.60	36.40	Total programme costs	38
Burkina Faso:				62
(a) Yako	0.40		Training, local administration, and opportunity cost of volunteers' time	
	2.40	7.60	As above, but including cost of community health programme	
(b) Koupele	2.70		Services of home economists	

^a More information on the programmes costed is contained in the text and Table 1.

^b Costs converted to 1982 US\$ using GDP deflators computed from data in *International financial statistics*.

^c See footnote c on page 1120.

among children under 5 years of age is 1.4 per 100 children per year (54).

With these assumptions, the cost per diarrhoea death averted in a child under 5 years is US\$ 1070. This figure is proportional to the cost per participating child and inversely proportional to the percentage reduction in mortality rate, which in turn is proportional to the prevalence of malnutrition (Table 2). The cost per diarrhoea death averted will be lower if it is possible to direct the programme only to malnourished children. For instance, if only children who are <75% weight-for-age participate, and if the proportion of such children before the intervention is 40% (Table 2), then with the same assumptions as above, the cost per diarrhoea death averted will be US\$ 430.

These tentative cost-effectiveness estimates are towards the lower end of the range of similar estimates being derived in this series of analyses of interventions for diarrhoea control. They are included here for illustrative purposes. They suggest that, despite the underestimation of effectiveness caused by excluding any effect of weaning education on food hygiene, weaning education may be an economically attractive diarrhoea control measure in some countries.

CONCLUSIONS

Evidence from 12 countries suggests that weaning education can improve the nutritional status of infants and young children. The effectiveness of weaning education depends in part upon the appropriateness of the design of the programme with regard to both the content of the messages and their method of delivery. Face-to-face communication by locally-recruited workers, reinforced by radio and other

mass media, may be the most effective delivery mechanism in some countries.

On the basis of theoretical calculations it is estimated that weaning education can reduce diarrhoea mortality rates by 2–12% in children under 5 years of age. These estimated mortality reductions exclude any effects of weaning education on food hygiene and any consequent reductions in both diarrhoea morbidity and mortality rates. Also excluded from the analysis is the impact of including messages concerning feeding during and after diarrhoeal illness. Preliminary estimates of cost-effectiveness suggest that weaning education may be an economically attractive intervention for reducing diarrhoea mortality, especially in countries with relatively high prevalence rates of moderate and severe malnutrition. In any particular country, policy on weaning education should be based upon local estimates of cost and effectiveness, and the expectation that weaning education will achieve other benefits in addition to diarrhoea mortality reduction in children under 5 years of age.

Several types of research are required to improve our understanding of the role of weaning education in diarrhoea control. First, studies are required in a variety of cultures to define in detail the nature of poor weaning practices, the reasons for them, maternal attitudes towards weaning, and the economic, physical and cultural constraints to changing deleterious practices. Such studies may highlight a need to develop affordable weaning foods of high energy and nutrient concentration. Second, studies are required into the design of locally appropriate educational messages and methods for their delivery. Third, it is necessary to measure the costs and impacts of pilot and full-scale weaning education programmes to test the provisional estimates given in this review and determine the correct emphasis to be given to such interventions in particular countries.

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RÉSUMÉ

INTERVENTIONS DANS LE CADRE DE LA LUTTE CONTRE LES MALADIES DIARRHÉIQUES DU JEUNE ENFANT: ÉDUCATION EN MATIÈRE DE SEVRAGE

Cet article est le dixième d'une série d'études relatives aux interventions susceptibles d'aider à réduire la morbidité et la

mortalité par diarrhée chez les enfants de moins de 5 ans dans les pays en développement. La présente analyse porte

sur l'effet de l'éducation en matière de sevrage sur la morbidité et la mortalité imputables aux maladies diarrhéiques.

Les programmes d'éducation en matière de sevrage de 12 pays en développement sont passés en revue. Bien qu'aucune des évaluations concernant l'efficacité de ces programmes ne conclue à la perfection, les résultats indiquent nettement qu'il est possible d'améliorer l'état nutritionnel des nourrissons et des jeunes enfants, même dans les communautés pauvres, en dispensant une éducation en matière de sevrage. Les entretiens en tête à tête avec des agents recrutés sur place, renforcés par des communications diffusées par la radio et les autres grands moyens d'information, sont peut-être le canal le plus efficace pour dispenser cette éducation.

Aucune étude ne semble avoir été faite sur le taux de diarrhée chez les enfants dont les mères ont reçu une éducation en matière de sevrage. On a cependant la preuve qu'un état nutritionnel médiocre prédispose à des attaques de diarrhée d'une gravité et d'une durée accrues et qu'il accroît le risque de mortalité par diarrhée. A partir de calculs théoriques, on a estimé que l'éducation en matière de sevrage pouvait réduire de 2 à 12% le taux de mortalité par diarrhée chez les enfants de moins de 5 ans. C'est dans les communautés où la prévalence de la malnutrition est la plus

élevée que l'on s'attend que l'éducation en matière de sevrage ait le plus d'impact. On a obtenu ces chiffres en se fondant sur l'hypothèse selon laquelle l'éducation en matière de sevrage pouvait améliorer l'apport alimentaire et réduire de moitié le nombre des enfants qui souffrent de malnutrition modérée ou grave.

Cette réduction estimative de la mortalité ne tient pas compte des effets de l'éducation en matière de sevrage sur l'hygiène alimentaire ni de toute réduction ultérieure des taux de morbidité et de mortalité par diarrhée. L'analyse exclut également l'impact des messages, compris dans l'éducation en matière de sevrage, concernant l'alimentation pendant et après l'épisode de diarrhée.

Les estimations préliminaires du rapport coût/efficacité de l'éducation en matière de sevrage indiquent que celle-ci peut constituer une intervention économiquement attrayante pour réduire la mortalité par diarrhée, surtout dans les pays où le taux de prévalence de la malnutrition modérée ou grave est relativement élevé. Des recherches devront être effectuées pour définir la nature et les déterminants des pratiques de sevrage inadéquates, pour concevoir des programmes appropriés d'éducation en matière de sevrage et pour en mesurer le coût et les effets.

REFERENCES

- ANDRIEN, M. *Evaluation du programme d'éducation nutritionnelle du Centre Hospitalier Régional de Bouaké*. Liège, Laboratoire de Pédagogie Expérimentale de l'Université de Liège, 1983.
- ANTROBUS, A. C. K. Programme planning and evaluation in community nutrition education. Report on the Lambs River Project, Jamaica 1971-1974. Kingston, Caribbean Food and Nutrition Institute, 1975 (CFNI-J-4-75).
- ASHWORTH, A. & FEACHEM, R. G. Interventions for the control of diarrhoeal diseases among young children: prevention of low birthweight. *Bulletin of the World Health Organization*, **63**: 165-184 (1985).
- BEAUDRY-DARISME, M. & LATHAM, M. C. Nutrition rehabilitation centers—an evaluation of their performance. *Journal of tropical pediatrics*, **19**: 299-332 (1973).
- BEGHIN, I. D. & VITERI, F. E. Nutrition rehabilitation centres: an evaluation of their performance. *Journal of tropical pediatrics*, **19**: 404-416 (1973).
- BENGOA, J. M. Nutrition rehabilitation programmes. *Journal of tropical pediatrics*, **10**: 63-64 (1964).
- BENGOA, J. M. Nutrition rehabilitation. In: *Nutrition in preventive medicine*, Geneva, World Health Organization, 1976, pp. 321-334.
- BERGGREN, W. L. Evaluation of the effectiveness of education and rehabilitation centers. In: *Proceedings of the Western Hemisphere Congress III, Bal Harbour, 1971*. New York, Futura, 1972, pp. 84-87.
- BLACK, R. E. ET AL. Malnutrition is a determining factor in diarrheal duration, but not incidence, among young children in a longitudinal study in rural Bangladesh. *American journal of clinical nutrition*, **39**: 87-94 (1984).
- BRANDTZAEG, B. ET AL. Dietary bulk as a limiting factor for nutrient intake—with special reference to the feeding of pre-school children. III. Studies of malted flour from ragi, sorghum and green gram. *Journal of tropical pediatrics*, **27**: 184-189 (1981).
- BRISCOE, J. The quantitative effect of infection on the use of food by young children in poor countries. *American journal of clinical nutrition*, **32**: 648-676 (1979).
- BROWN, J. E. & BROWN, R. C. An evaluation of nutrition centre effectiveness by measurement of younger siblings. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **73**: 70-73 (1979).
- BROWN, K. H. ET AL. Consumption of foods and nutrients by weanlings in rural Bangladesh. *American journal of clinical nutrition*, **36**: 878-889 (1982).
- CARLONI, A. S. Sex disparities in the distribution of food within rural households. *Food and nutrition (FAO)*, **7**: 3-12 (1981).
- CASSIDY, C. M. Benign neglect and toddler malnutrition. In: *Social and biological predictors of nutritional status, physical growth, and neurological development*. New York, Academic Press, 1980, pp. 109-139.
- CHEN, L. C. ET AL. Anthropometric assessment of energy-protein malnutrition and subsequent risk of mortality among preschool aged children. *American journal of clinical nutrition*, **33**: 1836-1845 (1980).
- CHURCH, M. & DOUGHTY, J. Value of traditional food practices in nutrition education. *Journal of human nutrition*, **30**: 9-12 (1976).

18. COOKE, T. M. Mass media and marketing approach to nutrition education. In: Shack, K.W., ed., *Teaching nutrition in developing countries, or the joys of eating dark green leaves*. Santa Monica, CA, Meals for Millions Foundation, 1977, pp. 75-85.
19. COWAN, B. & DHANOA, J. The prevention of toddler malnutrition by home-based nutrition health education. In McLaren, D.S., ed., *Nutrition in the community*. New York, Wiley, 1983, pp. 339-356.
20. DEARDEN, C. ET AL. Eating more fats and oils as a step towards overcoming malnutrition. *Tropical doctor*, **10**: 137-142 (1980).
21. DE ZOYSA, I. & FEACHEM, R. G. Interventions for the control of diarrhoeal diseases among young children: chemoprophylaxis. *Bulletin of the World Health Organization*, **63**: 295-315 (1985).
22. DE ZOYSA, I. & FEACHEM, R. G. Interventions for the control of diarrhoeal diseases among young children: rotavirus and cholera immunization. *Bulletin of the World Health Organization*, **63**: 569-583 (1985).
23. EIDE, W. B. Women in food production, food handling and nutrition. *Protein Advisory Group bulletin*, **7**: 40-49 (1977).
24. ESREY, S. A. ET AL. Interventions for the control of diarrhoeal diseases among young children: improving water supplies and excreta disposal facilities. *Bulletin of the World Health Organization*, **63**: 757-772 (1985).
25. FEACHEM, R. G. Interventions for the control of diarrhoeal diseases among young children: supplementary feeding programmes. *Bulletin of the World Health Organization*, **61**: 967-979 (1983).
26. FEACHEM, R. G. Interventions for the control of diarrhoeal diseases among young children: promotion of personal and domestic hygiene. *Bulletin of the World Health Organization*, **62**: 467-476 (1984).
27. FEACHEM, R. G. & KOBLINSKY, M. A. Interventions for the control of diarrhoeal diseases among young children: measles immunization. *Bulletin of the World Health Organization*, **61**: 641-652 (1983).
28. FEACHEM, R. G. & KOBLINSKY, M. A. Interventions for the control of diarrhoeal diseases among young children: promotion of breastfeeding. *Bulletin of the World Health Organization*, **62**: 271-291 (1984).
29. FEACHEM, R. G. ET AL. Diarrhoeal disease control: reviews of potential interventions. *Bulletin of the World Health Organization*, **61**: 637-640 (1983).
30. FRANKISH, J. G. Nutrition rehabilitation in Transkei. *South African medical journal*, **53**: 507-511 (1978).
31. GILMORE, J. W. ET AL. *Morocco: food aid and nutrition education* (AID project impact evaluation report No. 8), Washington, DC, Agency for International Development, 1980.
32. HEIMENDINGER, J. ET AL. In: Heimendinger, J. et al., ed., *Nutrition intervention in developing countries. Study IV. Formulated foods*. Cambridge, MA, Oelgeschlager, Gunn & Hain, 1981, pp. 34-75.
33. HOORVEG, J. & McDOWELL, I. *Evaluation of nutrition education in Africa*. The Hague, Mouton, 1979.
34. HOORVEG, J. & NIEMEIJER, R. *The nutritional impact of the pre-school health programme at three clinics in Central Province, Kenya* (African Studies Centre Research Report No. 11), Leiden, African Studies Centre, 1980.
35. JANSEN, R. & HARPER, J. M. Application of low-cost extrusion cooking to weaning foods in feeding programmes. Part 1. *Food and nutrition (FAO)*, **6**(1): 2-9 (1980).
36. JANSEN, G. R. & HARPER, J. M. Application of low-cost extrusion cooking to weaning foods in feeding programmes. Part 2. *Food and nutrition (FAO)*, **6**(2): 15-23 (1980).
37. JANSEN, G. R. ET AL. The calorie densities of gruels made from extruded corn-soy blends. *United Nations University food and nutrition bulletin*, **3**(1): 39-44 (1981).
38. JONES, E. M. & MUNGER, S. J. *Applications of a field guide for evaluation of nutrition education to programs in the Philippines*. Washington, DC, Agency for International Development, 1978.
39. KING, K. W. Assessing the preventive impact of nutrition education. In: Schürch, B., ed., *Evaluation of nutrition education in Third World communities* (Nestlé Foundation Publication Series Volume 3), Bern, Hans Huber, 1983, pp. 116-135.
40. KING, K. W. ET AL. Preventive and therapeutic benefits in relation to cost: performance over 10 years of Mothercraft Centers in Haiti. *American journal of clinical nutrition*, **31**: 679-690 (1978).
41. KUMARI, S. ET AL. Nutrition education: its impact on malnutrition. *Journal of tropical pediatrics*, **28**: 216-217 (1982).
42. KUSIN, J. A. ET AL. The preschool child in Suka village, North Sumatra. I. Feeding practices and measured food intake. *Paediatrica Indonesiana*, **21**: 147-160 (1981).
43. MARTORELL, R. ET AL. The impact of ordinary illnesses on the dietary intakes of malnourished children. *American journal of clinical nutrition*, **33**: 345-350 (1980).
44. MOSHA, A. C. & SVANBERG, U. Preparation of weaning foods with high nutrient density using flour of germinated cereals. *United Nations University food and nutrition bulletin*, **5**(2): 10-14 (1983).
45. ORR, E. The contribution of new food mixtures to the relief of malnutrition. *Food and nutrition (FAO)*, **3**: 2-10 (1977).
46. RITCHIE, J. A. S. Bridging the gap—some problems of communication and empathy in nutrition education. *Food and nutrition (FAO)*, **5**: 11-17 (1979).
47. ROBINSON, D. C. The nutrition rehabilitation unit at Mulago Hospital, Kampala: further development and evaluation 1967-1969. *Journal of tropical pediatrics*, **17** (monograph No. 13): 35-42 (1971).
48. ROY, A. K. ET AL. Community level malnutrition vis-à-vis the role of nutrition rehabilitation centre. *Indian journal of medical research*, **72**: 846-853 (1980).
49. RUTISHAUSER, I. H. E. Factors affecting the intake of energy and protein by Ugandan preschool children. *Ecology of food and nutrition*, **3**: 213-222 (1974).

50. RUTISHAUSER, I. H. E. & FROOD, J. D. L. The effect of a traditional low-fat diet on energy and protein intake, serum albumin concentration and body-weight in Ugandan preschool children. *British journal of nutrition*, **29**: 261-268 (1973).
 51. SCHNEIDEMAN, I. ET AL. The nutrition rehabilitation unit at Mulago Hospital, Kampala. Development and evaluation, 1965-67. *Journal of tropical pediatrics*, **17** (monograph No. 13): 25-34 (1971).
 52. SHAH, P. M. ET AL. Domiciliary management of kwashiorkor in a rural set-up: a longitudinal study of clinical, economic and social aspects. *Indian pediatrics*, **8**: 805-813 (1971).
 53. SHAH, P. M. ET AL. The impact of nutrition rehabilitation on the diet of children. *Tropical and geographical medicine*, **26**: 446-448 (1974).
 54. SNYDER, J. D. & MERSON, M. H. The magnitude of the global problem of acute diarrhoeal disease: a review of active surveillance data. *Bulletin of the World Health Organization*, **60**: 605-613 (1982).
 55. STANFIELD, J. P. The Luteete family health centre: nutrition rehabilitation in a comprehensive rural development strategy. *Journal of tropical pediatrics*, **17** (monograph No. 13): 67-82 (1971).
 56. UNDERWOOD, B. A. & HOFVANDER, Y. Appropriate timing for complementary feeding of the breast-fed infant. A review. *Acta paediatrica Scandinavica, Supplement*, **294**: 1-32 (1982).
 57. VIJAYARAGHAVAN, K. ET AL. India Population Project, Karnataka. Evaluation of nutrition education activities. *Hygie*, **1**: 9-14 (1983).
 58. VIRAVAIIDHYA, K. V. ET AL. *Impact of age/weight charts maintained in the home and nutrition education on nutrition status of infants and pre-school children*. Nutrition Division, Ministry of Public Health, Royal Thai Government, Bangkok, 1981.
 59. WEBB, R. E. ET AL. An evaluation of the education benefits of nutritional rehabilitation centres as measured by the nutritional status of siblings. *Journal of tropical pediatrics*, **21**: 7-10 (1975).
 60. WHO Technical Report Series, No. 477, 1971. (*Joint FAO/WHO Expert Committee on Nutrition: eighth report*).
 61. YANKAUER, A. An evaluation of nutrition classes for mothers in a pediatric clinic setting. *Journal of tropical pediatrics*, **21**: 90-92 (1975).
 62. ZEITLIN, M. F. Upper Volta case study of home-based community-level weaning food development. In: Heimendinger, J. et al., ed., *Nutrition intervention in developing countries. Study IV. Formulated foods*. Cambridge, MA, Oelgeschlager, Gunn & Hain, 1981, pp. 79-167.
 63. ZEITLIN, M. F. & FORMACION, C. S. Case study: using radio to teach enrichment of rice porridge in the Philippines. In: Zeitlin, M. F. & Formacion, C. S., ed., *Nutrition intervention in developing countries. Study II. Nutrition education*. Cambridge, MA, Oelgeschlager, Gunn & Hain, 1981, pp. 228-325.
 64. ZEITLIN, M. F. ET AL. Case study of the cost and effectiveness of preschool clinics in Ghana and Lesotho. In: Austin, J. E. et al., ed., *Nutrition intervention in developing countries. Study VII. Integrated nutrition and primary health care programs*. Cambridge, MA, Oelgeschlager, Gunn & Hain, 1981, pp. 97-138.
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