Weaning Foods: Characteristics and Guidelines

Abstract: Weaning foods are generally introduced between the ages of six months to three years old as breastfeeding is discontinued. While breastfed infants are often able to maintain adequate growth through their sixth month, additional nutrients are required to complement or, in some cases, replace breastfeeding completely. The main concern is making sure that there is no gap between nutrient requirements and what a child is able to consume, absorb, and utilize. Nutritional status in children is most vulnerable during the weaning stages when both macro and micronutrients may be insufficient to maintain growth and development. Protein-energy malnutrition and micronutrient under-nutrition occur together. It is an important part of weaning strategies to optimize nutritional status and to tackle under-nutrition-related problems as a group for maximum effectiveness. Traditionally, weaning foods are liquids and semisolids which are later replaced by foods eaten by older family members. In some cases these types of foods can be filling and yet not meet the child's nutrient needs. Establishing appropriate characteristics for nutrients and other aspects of weaning foods that assist in motor skills and mental development will be important to assure the appropriateness of targeting foods to this age group.

Background

10 million children under the age of 5 years old die each year. More than half of the deaths occur because of malnutrition. If adequate health systems were in place nearly 2/3 of the deaths could be prevented. Part of the health systems picture is to promote appropriate feeding practices for infants and young children.

While if at all feasible breastfeeding is recommended during the first six months, the most vulnerable period for developing under-nutrition remains the transition from breastfeeding to family foods. Breast milk composition may vary dramatically between women and from the beginning and month six.[1 2] Additional foods may be required to complement or replace breast milk after this time. Generally, children double their birth weight by 6 months of age and triple it by 12 months. During the first month of life, the energy cost for growth is approximately 35% of calories consumed (assuming an adequate calorie intake). This number declines to around 3% at the age of 12 months. Energy needs range between 500-800 kcal/day, or approximately 95 kcal/kg/day, during the six-month weaning period and girls tend to need slightly fewer kcalories than boys (at least 541 kcal/day vs. 603 kcal/day).

The weaning period is crucial for the maintenance and continued growth and development of the child and yet it is often the time when foods are given to provide the volume necessary to keep the child from being hungry without regard to the nutritional quality of the transitional foods. In addition, a reduction in breast milk consumption and the protection it

provides during gastrointestinal infection can increase the risk for diarrheal illness in children during weaning.[3] Nutrition-related problems should be identified and counseling should be implemented to promote appropriate feeding practices.[4] [5] [6]

Children can develop multiple nutrient deficiencies and it will be important to improve all nutritional parameters at the same time in order to have the best impact on health outcomes. For instance, protein-energy malnutrition can impair iron absorption. Providing iron without addressing protein-energy malnutrition is likely to be less effective and have more potential for adverse effects that can occur with iron supplementation.

Economic and social issues will affect the acceptability and sustainability of weaning food strategies. Integrating weaning products and strategies into the health and social infrastructures that exists for the care and treatment of mothers and their children may be most effective. Multiple products may be required to help to address disparities in financial capacity and social traditions.

Characteristics of Weaning Foods

Guidelines for weaning foods suggest that weaning can occur between the ages of 6-12 months. The foods given should have characteristics according to nutritional needs, appropriate textures and viscosity, and appropriate forms (liquid, semisolid, solid) to support mental and physical development. Special attention should be paid to microbial safety during these months as the immune system is still maturing and the protection provided by mother's milk may not be present. For a summary of weaning food characteristics and recommendations, see Table 1.

Digestion and absorption capacity of the gastrointestinal tract may still be relatively immature during the early weaning period and can impact the effectiveness of weaning foods and the ability to recover nutritional status in malnourished children.[7] [8]

In the case of maternal HIV infection, recommendations are different in that exclusive breastfeeding should be followed by immediate weaning rather than mixed feeding or complementary feeding as is commonly recommended in non-HIV infected populations. This can place the child at additional risk during the gap between breastfed and fully weaned.[9]

Whatever the circumstance, mothers/care givers will require clear and appropriate information on which to base their choices for child feeding and the introduction of non-breast milk foods.[10]

Between the ages of 6-8 months pureed and mashed foods can be introduced and given from a cup or bowl. Viscosity of the foods can affect the volume and nutrient consumption of the weaning foods and this can be used to advantage by individualizing the instructions for an undernourished child.[11] [12] From 8-12 months of age cut up foods that can be handled by the

child are appropriate. After 12 months of age, family foods should be relied on for nutrient supplies.

There can be a variety of food sources that can offer the mix of nutrients required (see Table 2 for recommended intakes for 7-12 month old children). Foods that are lacking can be fortified with protein and micronutrients with special care to assure that amounts are adequate, but care should be taken to avoid high-doses.

Of special interest in resource-limited settings is the ability to provide iron-rich weaning foods.[13] Meats provide a good source of bioavailable heme-iron, but may not be available or economically feasible for some families. Plant sources of iron should include other food sources of vitamin C to enhance the bioavailability of the non-heme iron provided. Fortification with iron is also an option as long as weaning foods contain appropriate amounts of both iron and vitamin C.

Recipes and instructions on preparation for the preservation of nutrients and the assurance of safety are important features of introducing home-processed or home-prepared weaning foods. Mothers/care givers should be instructed on how to introduce a cup or bowl for feeding with better hygiene. In addition, general food handling precautions, such as hand washing before and after food preparation, careful cleaning of utensils, and appropriate food preparation and storage methods should be included in education activities.

Specific recommendations include assuring adequate fluid provision. Vitamin-rich fruits and vegetables should be provided every day along with adequate protein sources. Fortified foods are recommended and vitamin-mineral supplementation is recommended where fortified foods are not available. Animal foods or adequate substitutes should be provided to assure a source of quality protein and other nutrients.[14] Ready-to-use products are especially appropriate where animal foods and breast milk substitutes are less commonly available.

Weaning foods should have good acceptability by both the mothers/care givers and the infants. It is possible that the child's feeding preferences are set early by foods and beverages that may be used as an adjunct to breastfeeding as early as the first week of life.[15,16] Local foods and fortifying ingredients have been utilized creatively with acceptability in mind.[17,18,19,20,21,22,23,24] Ingredients should meet expected standards for nutrient content and value as well as food safety. Sources of fluids, calories, protein, and other nutrients can include a wide variety of ingredients that are likely to range in acceptability by mothers/care givers as well as children.[25]

The development and introduction of weaning foods that meet both generally-accepted guidelines and local preferences requires testing in areas where the product is proposed for use.[26,27]

Policy Considerations

In addition to the characteristics, policy guidelines and directives should be considered in the development, distribution, and commercialization of weaning foods. Several policy recommendations and regulations are available online. Guidelines are not always clear to the end user and definitions that pertain to other populations may not transfer well to weaning foods. Such is the issue of "fiber" and "non-digestible carbohydrates", of which the former can be problematic in feeding young children and the latter has been suggested as helpful in supporting the colonization of the gut with beneficial bacteria.[28]

Policy development requires research on which to build evidence-based practice guidelines. Outcomes from processing to health impact require documentation for the recommendation of feasible methods and materials for weaning foods.[29] [30]

Examples of guidelines include the World Health Organization's International Code of Marketing of Breast Milk Substitutes,[31] Baby Friendly Hospital Initiative,[32] the Innocent Declaration from the "Convention of the Rights of the Child",[33] [34] [35] and Codex Alimentarius,[36] among others. In addition, each country is likely to have governmental regulations that pertain to the development, distribution, and marketing of infant weaning products.

Summary

Weaning foods and products have been in the limelight over the last few years as childhood malnutrition and mortality continue to be confounding issues in the pursuit of improving global health outcomes. Both ingredients and ready-to-use weaning foods should be developed with social, economic, and health factors in mind. Regulations and guidelines have been recommended by global organizations, such as the World Health Organization, and local regulatory and professional groups. Processors should be aware of the many factors to consider in developing and marketing weaning foods to make sure that the impact is positive and the improvements are purposeful and measurable.

Resources

Literature reviews on weaning foods and projects can be found using key words at www.pubmed.com. Additional reading may include the items in footnotes and the following:

Child Feeding

Suggestions for anthropometric indicator reporting on child nutrition. This scheme could be used when testing effectiveness of weaning foods to maintain and improve nutritional status:

Nandy S, Irving M, Gordon D, Subramanian SV, Smith GD. Poverty, child undernutrition and morbidity: new evidence from India.

Linkages Project: Infant Feeding Options in the Context of HIV. Updated May 2005. Available at: http://www.linkagesproject.org/media/publications/Technical%20Reports/Infant_Feeding_Options.pdf

Various complementary feeding publications through the Linkages Project. Available at: http://www.linkagesproject.org/technical/compfeeding.php

Recommendations for complementary feeding practices.
Optimal complementary feeding practices to prevent childhood malnutrition in developing countries. From the Food and Nutrition Bulletin. WHO. Available at: http://www.micronutrient.org/idpas/pdf/284OptimalComplementary.pdf

Food Processing

Food Processing Case Study in Kenya. A description of a project to build local processing industry.
Maretzki AN. Lessons learned through the NutriBusiness Project in rural Kenya. Presentation at 38th Society for Nutrition Education, July 27, 2004. Available at: http://www.sne.org/documents/GlobalNutritionEducationLessonsLearnedAudreyMaretzki.doc

Sensory evaluation of selected weaning food formulations.
Onuorah Ce, Akinjede FA. Comparative evaluation of four formulated weaning foods and a commercial product. Nigerian Food Journal. 2004;22:48-53. Abstract at: http://www.ajol.info/viewarticle.php?jid=231&id=20603&OJSSID=827d7d6fcbfa38bc5dd4c34d153eeb81

Iron in weaning foods: an evaluation of options.
Davidsson L, Kastenmayer P, Szajewska H, Hurrell RF, Barclay D. Iron bioavailability in infants from an infant cereal fortified with ferric pyrophosphate or ferrous fumarate. Am J Clin Nutr. 2000;71:1597-1602.

Report of banana and soy weaning food in Uganda.
Katebarirwe JG, Nabugoomu F, Muranga FI. Optimisaation of soy incorporation in banana based weaning foods. Abstract available at: http://www.pronutrition.org/archive/200508/msg00061.php

Soy-fortified weaning foods
Annan NT, Plahar WA. Development and quality evaluation of a soy-fortified Ghanaian weaning food. Available at: http://www.unu.edu/unupress/food/8F163e/8F163E0f.htm

Espinola N, Creed-Kanashiro H, Ugaz ME, van Hal M, Scott G. Development of a sweet potato-based instant weaning food for poorly nourished children six months to three years old. CIP Progress Report 1997-1998; 295-302.

Zanna MSH, Milala MA. Effect of supplementation of ogi a pearl millet based Nigerian weaning food, with cowpea, on chemical composition, sensory and *in vitro* protein digestibility. J Biol Sci. 2004;4(5):654-657.

Tables

Table 1. Weaning food characteristics

Consideration	Description	Weaning food comments
Early breastfeeding cessation	The mother doesn't initiate breastfeeding or ends breastfeeding earlier than the recommended six months	Breastmilk replacement; generally liquid with modified milk or substitute to meet neonatal nutrient needs
Abrupt breastfeeding cessation at six months or later	The mother abruptly stops breastfeeding according to guidelines because of HIV infection or other reason	Weaning foods are generally semi-solid and in the form of porridges from 6-8 months and then in the form of small solid foods until the 12th month when family foods are integrated
Frequency of feeding	Variations in feeding times occur due to cultural and resource difference; mother/ care taker time may be a consideration in frequency of feeding and the viscosity of the foods.	Feeding is recommended at least four times daily with foods that have an energy density of at least 85 kcal/100 grams. If this is not feasible and if the child requires additional nutrients for catch-up growth, then more nutrient dense weaning foods may be required at more than 120 kcal/100 gram density.
Micronutrients	The quality of the diet should be well-rounded for micronutrients, especially vitamin A, calcium, and iron. The Recommended Nutrient Intake (RNI) is equivalent to the Recommended Dietary Allowance (RDA) in the U.S.	Fortification ingredients or formulas may be required. General nutrition catch-up is important to the ability to absorb and utilize micronutrients, so the weaning foods should concentrate on priorities of fluids, calories, protein, and then micronutrients. Also, it may be necessary to assure combinations that enhance optimal nutrient absorption, such as assuring a vitamin C source with iron-rich plant-based foods.
Knowledge	Mothers and care providers should be well-informed of choices they make in the weaning process due to the high vulnerability of the child	The development of weaning foods should be based on needs and should include clear instructions and options for the use of the products or

Consideration	Description	Weaning food comments
	during this time.	ingredients. Cultural beliefs and traditions as well as the potential for stigma should be considered in the development and distribution of weaning foods. Community-based and government-based organizations should also be included in the education and implementation process. Teaching face-to-face is an effective way to communicate information on the products/ ingredients.
Cost and availability	Economic and geographical constraints affect food choices.	Weaning foods need to consider economic feasibility.
Sustainability	Both the availability and the reinforcement of education should be a part of promoting optimal feeding practices.	Promotion of behavioral change is an ongoing process and will require a long-term plan for the availability of the product and appropriate reinforcement once it is introduced. Wherever possible, recipes can be included to allow for variety of uses with the products and/or ingredients
Storage	Storage capability varies widely according to geographic location and socio-economic issues	Shelf-life should be a consideration in processing. With the use of local ingredients, clear instructions on mixing and storing products are important to nutrient stability and safety.

Table 2. Dietary Reference Intake Recommendations[37]

Nutrient	**RDA 7-12 mo**
Energy (kcal)	743
Carbohydrate	95 g/d
Protein	11 g/kg/d
Fat	30 g/d
Protein	13.5 g
Vitamin A (ug/d)	500
Vitamin C (mg/d)	50
Vitamin D (mg/d)	5
Vitamin E (mg/d)	5
Vitamin K (mg/d)	2.5
Thiamin (mg/d)	0.3
Riboflavin (mg/d)	0.4
Niacin (mg/d)	4
Vitamin B6 (mg/d)	0.3
Folate (ug/d)	80
Vitamin B12 (ug/d)	0.5
Pantothenic acid (mg/d)	1.8
Biotin (ug/d)	6
Choline (mg/d)	150
Fluoride (mg/d)	0.7
Iron (mg/d)	40
Selenium (ug/d)	45
Zinc (mg/d)	5

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