COMPLEMENTARY FEEDING
OF INFANTS AND YOUNG CHILDREN

Report of a technical consultation
supported by WHO, UNICEF
University of California/Davis and ORSTOM

28 - 30 November 1995
Montpellier, France
Acknowledgements

This document was prepared by WHO’s Programme of Nutrition under the direction of Dr Graeme Clugston, and Ms Randa Saadeh, technical officer, who had overall responsibility for the activity.

WHO gratefully acknowledges the contribution of the Tropical Nutrition Laboratory of ORSTOM at Montpellier (France) for hosting the Consultation and assisting in the preparation of its report; UNICEF and UNU for their financial and technical support; and the Programme for International Nutrition at the University of California at Davis (USA) for its scientific input.

Special thanks are also due to Dr Djamil Benbouzid for his technical and organizational inputs.

© World Health Organization, 1998

This document is not issued to the general public, and all rights are reserved by the World Health Organization (WHO). The document may not be reviewed, abstracted, quoted, reproduced or translated, in part or in whole, without the prior written permission of WHO. No part of this document may be stored in a retrieval system or transmitted in any form or by any means— electronic, mechanical or other— without the prior written permission of WHO.

The views expressed in documents by named authors are solely the responsibility of those authors.
# Table of contents

<table>
<thead>
<tr>
<th>Executive summary</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background and objectives</td>
<td>1</td>
</tr>
</tbody>
</table>

**Opening session:**

<table>
<thead>
<tr>
<th>Session 1</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 The state-of-the-art review - description of the process</td>
<td>7</td>
</tr>
<tr>
<td>1.2 Socioeconomic and cultural context of child feeding</td>
<td>8</td>
</tr>
<tr>
<td>1.3 Breast-feeding, infant growth and the age of introduction of complementary foods</td>
<td>9</td>
</tr>
<tr>
<td>1.4 Duration of the need for special transitional foods</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 2</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Energy and nutrient requirements from complementary foods</td>
<td>12</td>
</tr>
<tr>
<td>2.2 Energy density, frequency of feeding and other factors affecting the intake of complementary foods</td>
<td>12</td>
</tr>
<tr>
<td>2.3 Introduction of the working groups</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 3</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 First Report of the working groups</td>
<td>14</td>
</tr>
<tr>
<td>Working group 1: Resource and environmental constraints in complementary feeding</td>
<td>14</td>
</tr>
<tr>
<td>Working group 2: Energy density of complementary foods</td>
<td>16</td>
</tr>
<tr>
<td>Working group 3: Care issues in relation to complementary feeding</td>
<td>17</td>
</tr>
<tr>
<td>Working group 4: Timing of the introduction of complementary foods</td>
<td>17</td>
</tr>
<tr>
<td>3.2 Protein and micronutrient requirements from complementary foods of infants and young children up to 2 years of age</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 4</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Food quality and processing</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 5</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Child feeding practices</td>
<td>23</td>
</tr>
<tr>
<td>5.2 Programmatic interventions to improve complementary feeding</td>
<td>23</td>
</tr>
<tr>
<td>5.3 A review of some programmes that aim to improve complementary feeding practices through behaviour change</td>
<td>24</td>
</tr>
</tbody>
</table>

Recommendations: Feeding recommendations; Research recommendations | 27 |

<table>
<thead>
<tr>
<th>Annex I</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting Agenda</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annex II</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Joint WHO/UNICEF Complementary Feeding Initiative</td>
<td>38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annex IIIa</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO Global Data Bank on Breast-feeding</td>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annex IIIb</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive breast-feeding and median duration of breast-feeding</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annex IIIc</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators &amp; definitions of breast-feeding practices at household &amp; health-facility levels</td>
<td>42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annex IV</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy density of foods required to attain different total daily energy intakes at various feeding frequencies (Table 13 of the state-of-the-art paper)</td>
<td>45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annex V</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy needed from complementary foods for children in developing countries (Table 11 of the state-of-the-art paper)</td>
<td>46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annex VI</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of participants</td>
<td>47</td>
</tr>
</tbody>
</table>
Executive summary

WHO and UNICEF jointly convened an Expert Consultation on "Complementary Feeding of Infants and Young Children" in Montpellier, France, from 28 to 30 November 1995. The two agencies had commissioned the Programme for International Nutrition, University of California at Davis (USA), to prepare a state-of-the-art review of existing scientific information on complementary feeding, which served as the background document for the consultation.

The objectives of the meeting were: to review, discuss and suggest revisions to the state-of-the-art background paper; to achieve a scientific consensus that could serve as a sound basis for programming guidelines to strengthen existing interventions and develop new strategies; and to identify those areas where research is needed to clarify unresolved programme-oriented related questions, in order to achieve optimal infant feeding practices.

The meeting was hosted by the Tropical Nutrition Laboratory of ORSTOM, a WHO Collaborating Centre for Nutrition, and was attended by 35 participants and experts including representatives from WHO, UNICEF, University of California at Davis, UNU and ORSTOM.

The head of the Health Research Department of ORSTOM opened the meeting, and introductory remarks were presented by WHO and UNICEF. The participants elected Dr A. Tomkins (UK) and Dr C. Victora (Brazil) respectively as chairman and vice-chairman, and Dr A. Ashworth (UK) and Dr K. Tontisirin (Thailand) as rapporteurs of the meeting. The meeting agenda followed the layout of the chapters of the state-of-the-art document.

During the first session, the authors of the state-of-the-art review described the process of elaborating the document. The terminology relevant to complementary feeding was examined. An important issue is the risk of displacement of breast milk by the untimely introduction of complementary foods. The socioeconomic and cultural context of child feeding was presented. The rationale for breast-feeding at different ages of the child was outlined and the issue of the timing of introduction of complementary foods was reviewed in relation to child growth. Results of observational studies are conflicting, however an experimental study in Honduras showed no advantage, in terms of growth, of complementing before 6 months. The duration of the need for special transitional foods was discussed; it was agreed that, at 12 months, most children can eat normal family foods. Commenting on these issues, participants suggested that more research was needed, particularly experimental trials, to develop new, more precise recommendations on when to introduce complementary foods and on the duration for feeding specially prepared complementary foods. Participants decided to concentrate on issues of complementary feeding from six months onwards.

The second session was devoted to energy needed from complementary foods, the basis for estimating needs, and major factors affecting energy intake from complementary foods, in particular energy density and feeding frequency. Participants pointed out that results presented in the state-of-the-art document showing energy densities required for different feeding frequencies should be re-analysed before they are applied to breast-fed non-malnourished children.

Several issues were identified as themes for further discussion in working groups:

- Resource and environmental constraints to complementary feeding.
- Methodological issues for studies on the timing of introduction of complementary foods.
- Energy density of complementary foods.
- Care issues in relation to complementary feeding.
During the third session, the working groups presented their first reports followed by an examination of protein and micronutrient requirements from complementary foods, and how complementary foods can provide adequate nutrient density. It was thought that meeting iron and zinc needs might be very difficult with unfortified complementary foods. Vitamin A needs can be met with reasonable amounts of a variety of foods but in some situations, e.g. when the breast milk content of an infant's diet is low, needs may be higher and more difficult to meet. Several participants noted the discrepancies between estimated requirements from complementary foods and epidemiological evidence for iron and vitamin A deficiency, and suggested that further research was needed on the bioavailability of micronutrients from complementary foods.

Issues of food processing and safety were reviewed during the fourth session. Fermentation is efficient in preventing bacterial growth in complementary foods and low-viscosity foods are of interest because, inter alia, they reduce the time needed to feed the child. Participants emphasized the need for further research on the effect of these processes on the bioavailability of nutrients and on the acceptability of processed foods.

Programmatic interventions to improve complementary feeding were reviewed during the fifth session and a conceptual framework was presented. Practices that are amenable to change were identified and characteristics of programmes that have been successful in improving practices were outlined. Participants commented on the inadequacy of evaluation, and on the need to assess sustainability of programmes and develop criteria for establishing priorities. The authors of the state-of-the-art paper agreed to complete this section.

During the sixth and final session, feeding recommendations and research recommendations formulated by the working groups were examined, discussed and adopted. Authors of the state-of-the-art review agreed to revise/complete sections of the document relative to:

- breast-feeding;
- the timing of the start of complementary feeding; or the introduction of complementary foods;
- protein and micronutrient requirements to include information on needs for fat and essential fatty acids;
- food safety.

They urged participants to provide relevant national data which could be reviewed and included in the document. Follow-up to the meeting and publication of the state-of-the-art review were discussed. WHO was given the responsibility for preparing the report of the joint meeting.
List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRSP</td>
<td>Cooperative Research Support Programme, USAID (Egypt, Kenya, Mexico)</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>IDECG</td>
<td>International Dietary Energy Consultancy Group</td>
</tr>
<tr>
<td>ORSTOM</td>
<td>Institut français de recherche scientifique pour le développement en coopération</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
</tr>
<tr>
<td>UNU</td>
<td>United Nations University</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development, Washington, DC</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WINGS</td>
<td>Weaning Intervention through Growth Surveillance (Philippines)</td>
</tr>
</tbody>
</table>
Background and objectives

The period of transition from exclusive breast-feeding to consumption of the usual family diet with the complete cessation of breast-feeding is a critical period for infants and young children. In order to establish a sound basis for developing and implementing appropriate recommendations concerning complementary feeding, WHO and UNICEF have launched a joint initiative on this topic (Annex II).

WHO and UNICEF commissioned the Programme for International Nutrition, University of California at Davis (USA), to prepare a state-of-the-art review of existing information on complementary feeding. A technical consultation of experts was convened in Montpellier, France from 28 to 30 November, 1995, at the Tropical Nutrition Laboratory of ORSTOM, a WHO Collaborating Centre in Nutrition.

The main objectives of the consultation were:

- To review, discuss and suggest revisions to the state-of-the-art paper.
- To draw from this paper and the discussion a scientific consensus which could serve as a sound basis for programming guidelines to strengthen existing interventions and develop new strategies.
- To identify those areas where programme-oriented research is needed to clarify unresolved questions in order to achieve optimal infant feeding practices.

---

1 This review will be referred to as the “state-of-the-art paper” throughout this document.
2 Partial support for this paper was provided by the USAID’s Bureau for Africa, Health and Human Resources Analysis for Africa (HRAA) Project, through the Support for Analysis and Research in Africa (SARA) contract AOT-04830-C-2178-00.
Opening session

The meeting was opened by B. Philippon, head of the Health Department, ORSTOM.

Welcoming address
B. Philippon, Head, Health Department, ORSTOM, Montpellier

On behalf of ORSTOM, it is both a great pleasure and an honour for me to welcome you to Montpellier, particularly in this beautiful setting of the Agropolis campus. Montpellier is a thousand year old Mediterranean city. It hosts a famous School of Medicine, known to be one of the oldest in the world. The Montpellier tradition of Health Management and Research has been continued and the ORSTOM Research Centre with its 350 researchers and trainees is integrated into one of the largest research complexes of Southern Europe.

ORSTOM is a 50-year old French Government research institute, the full official name of which is The French Scientific Research Institute for Development through Cooperation. This indicates clearly that ORSTOM is devoted to applied research in a variety of disciplines, the aim of which is development. The research programmes are carried out through contractual agreements with national teams from developing countries, with the objective of promoting the emergence of national research teams.

Among the ORSTOM Research Departments, ours deals with health research. Approximately 200 people are involved, 120 senior professionals and 40 field officers. The Health Department is organised in 5 research units, dealing, respectively with communicable diseases, environment and health relationships, societies, population and health, natural substances of biological interest, and finally, the Nutrition Research Unit.

When we look at this gathering of international experts, we have a feeling both of achievement and of the challenges that lie ahead.

Firstly, this meeting is an achievement for us as part of the collaboration between ORSTOM and the World Health Organization, which started with the establishment of our Tropical Nutrition Laboratory as a WHO Collaborating Centre. As part of our joint programme of work, we agreed to convene a large consultation on infant feeding. The Joint Intercountry Workshop on Complementary Feeding for African French-speaking Countries was held in Alexandria in November 1994, as a preparatory phase. This meeting set the stage for the present consultation. We are pleased to have contributed to the launching of the Joint WHO/UNICEF Initiative on Complementary Feeding.

Secondly, the original purpose of this meeting goes beyond complementary feeding considered from the food technology and safety standpoints. There are other important questions which need to be answered. If all the answers are not found during this meeting, we may need to consider further research in many different domains. The field is therefore wide open for strong interagency cooperation and multi-centre activities and we are ready to join forces.

ORSTOM works mostly in developing countries and has many years of experience in the field of nutrition, including infant and young child feeding. Among other things, we have carried out surveys on the nutritional status and weaning practices in Senegal and in the Congo. Studies were performed to improve the nutritional value of transitional foods, e.g. their energy density and formulation. The results have been used to define strategies for child feeding, both in urban and rural settings. The evaluations of these strategies is ongoing. We have gained experience and expertise in the household and artisanal production of weaning foods, and also in small-scale industrial food processing units. We are happy to have the opportunity to share this knowledge with our colleagues from around the world.
In the past, whenever there was some interest in child feeding, the focus has been mostly on breast-feeding, while issues of the complementary feeding period were relatively neglected. At that time, questions on what, when and how to give complementary foods to children were not considered as important as those related to breast-feeding. Although breast-feeding still remains the optimum feeding practice until the end of the first semester, it is now essential to provide health and social workers, all over the world, with the necessary information and guidelines on how to proceed when introducing complementary feeding. This is the general aim of this meeting and we hope that during the forthcoming three busy days you will be able, firstly, to reach a consensus on the scientific evidence, and secondly, to decide what is needed in terms of additional studies and research. May I take this opportunity to wish you all success and good luck in this task.
Introductory remarks by WHO

R. Saadeh & M. de Onis, Division of Food and Nutrition, WHO, Geneva

On behalf of WHO it is an honour and a pleasure for us to welcome you all here in Montpellier on this very important occasion. We would like to thank our collaborating centre, ORSTOM, for hosting the meeting and offering us such excellent working conditions.

All of us in WHO and UNICEF have been especially keen to see this long overdue consultation on complementary feeding finally convened. The Plan of Action of the International Conference on Nutrition urges that governments should “Promote sound weaning practices, including timely introduction of supplementary foods, adequate quantity and quality of weaning foods and improved feeding practices, such as more frequent and supervised feedings”. Since the ICN, two resolutions of the World Health Assembly, in 1992 and 1994, on infant and young child nutrition have also called for intensified action in the area of complementary feeding.

Considerable progress has been made in terms of general knowledge about infant feeding from both scientific and practical standpoints. From their mother’s breast to the usual family diet, infants and young children follow a traditional and natural pathway with well-known milestones. Is the current pathway adequate? Are the milestones appropriately placed? We, as professionals, have begun to have doubts, but concerned public voices are also calling for answers to apparently simple questions. This is why WHO decided, jointly with UNICEF, to launch a complementary feeding initiative whose first priority is to examine the current status and establish a sound scientific platform on which to build our recommendations for appropriate complementary feeding practices.

We should like to commend our colleagues from the University of California at Davis, and others who have contributed, for putting together the state-of-the-art review paper. It is not only comprehensive, but also opens up broad avenues for operational research. And although we would not wish to anticipate our discussions, we believe it is accurate to say that there is general agreement about the essential points identified for careful review in the days ahead:

- a definition of "optimal timing" for complementing the diet of an exclusively breast-fed infant;
- how timing of complementary feeding relates to the infant’s nutritional requirements and how this can be measured using anthropometric parameters;
- the kinds of foods that should be offered and in what quantities;
- the minimum social, cultural and environmental conditions in which a mother (a household) is able to identify and choose the best feeding practices.

Even if it should strike some of you as a curious observation, we believe it is important to recall that the focus of our meeting is complementary feeding and not breast-feeding. So much more attention has been devoted to breast-feeding than to complementary feeding in the last two decades. Protecting, promoting and supporting breast-feeding remains a major joint priority, of course. However, if questions have been raised about complementary feeding it is because disinterested parties have failed to provide both health professionals and the general public with adequate information on the subject, including educational materials, handbooks and guidelines for training health personnel from grassroots to post-graduate levels. In fact, among UN agencies there is still no single set of agreed principles governing complementary feeding policy. Indeed, it is not as if there were two ways to feed infants and young children, first by breast alone then by giving complementary foods. The two are inseparable parts of the same continuum, which is perhaps the strongest argument in favour of ceasing to use the term "weaning" when referring to the complementary-feeding period.
The paper in front of you reviews a mass of scientific evidence from all over the world, including data collected by WHO on exclusive breast-feeding and the nutritional status of children under five years of age. We would now like to briefly summarize this information's main features.

The Global Data Bank on Breast-feeding, which is maintained in the Programme of Nutrition of WHO, has been recently restructured and updated reflecting the current breast-feeding indicators and definitions.

From data available in the data bank some observations can be made, which we will briefly summarize here. For all regions, rates are high for ever breast-fed infants, meaning that nearly all infants have been breast-fed at some point during their life. However, when considering infants less than 4 months of age who are being exclusively breast-fed, the rates drop drastically, for example to 2% in Nigeria, 4% in Niger, and 7% in Paraguay and Senegal. It is estimated that 35% of the world’s infants under 4 months of age are exclusively breast-fed (Annex III a, b and c).

Mixed feeding is also a common practice in most regions. Along with breast milk, most babies less than 4 months of age in Africa and the Eastern Mediterranean are receiving water, whereas in Central and South America, they are supplemented with infant formula. For example, in Colombia the rate for breast-fed infants under 4 months of age who also receive water is 7%, while those breast-fed infants receiving formula is 51%. In Yemen, the percentage of infants less than 4 months of age receiving water is as high as 76%, with 15% of infants being exclusively breast-fed.

Infants should begin receiving complementary foods, i.e. semi-solid or solid food, in addition to breast milk in accordance with WHO recommendations. Examining the data on complementary feeding from different regions, we find great variations both between regions and among countries within the same region. For example, the proportion of breast-fed infants 6-9 months of age receiving complementary foods is 90% in Kenya, 52% in Egypt and 23% in the Dominican Republic. In general, where information is available, rates are high in Latin America with the exception of the Dominican Republic; median in Africa; and low in the Eastern Mediterranean.

The WHO Expert Committee on Physical Status: the use and interpretation of anthropometry,¹ many of whose members are present today, and in particular the Committee's Working Group on Infant Growth, has recently performed analyses that are "a prelude to developing a new reference for infant growth".

In preparation for the WHO Expert Committee meeting, a Working Group on Infant Growth was established to assess the growth patterns of infants following current WHO feeding recommendations, and the relevance of such patterns to the development of growth reference data. The study found that infants fed according to WHO recommendations, and living under conditions that favour the achievement of genetic growth potential, grew less rapidly than, and deviated significantly from, the current reference. As shown by the Working Group's analyses, the diagnosis of slackening in weight gain using the current international reference occurs on average at three months of age, whereas if the "12-month breast-fed pooled data set" were used, a slackening in weight gain would not be noted until approximately five months. The two-month premature introduction of supplementary foods could result in life-threatening consequences to the young infant in many settings.

In view of the limited value of the current international growth reference it was concluded that a new growth reference is needed, which enhances the nutritional management of infants. The analyses were sufficient to support the recommendation that the reference sample be chosen from a population of infants who are fed according to WHO feeding recommendations and live in "healthy" environments which do not limit growth, and are representative of characteristics influencing the normal variance in growth, e.g., birth weight and parental height.

Given the capital importance of these issues to infant health and survival, WHO is continuing its work in developing a new international growth reference. The WHO Programme of Nutrition has established a new working group that is responsible for developing the protocol for a multi-centre growth reference study, which will be implemented in six countries in various geographical regions. WHO and its partners are also in the process of refining the definition of "optimal" growth as measured by accepted functional indicators of infant health and well-being. Finally, WHO strongly encourages further research directed towards filling gaps in knowledge and solving the crucial questions identified by the Working Group's analyses to strengthen the technical basis for protecting and promoting sound infant nutrition.

Finally, we would like to thank the experts who have agreed, sometimes at very short notice, to enrich our discussions by sharing their broad and varied experience. Participants' regional distribution is a significant asset. Multiple ecological, cultural and social facets of our "global village" will thereby be reflected both in our deliberations and final product.

Introductory remarks by UNICEF

D. Alnwick, UNICEF, New York

WHO and UNICEF have been working together for a long time. Together they have been successful in protecting, promoting and supporting breast-feeding and in combating some micronutrient deficiencies such as iodine and vitamin A deficiency. But there has been less progress with protein-energy malnutrition to prevent stunting and other growth problems.

We live in a rapidly changing environment, which poses new challenges to young child feeding. With the advent of the free market economy and of global capitalism, pressures have increased on health workers and on families in the developing world. In this context, strategies to improve child feeding should be mapped out, and minimum sets of standards and monitoring mechanisms should be identified. There is now a wealth of knowledge that should be put into action. The goal of this meeting is to review the scientific evidence on which appropriate recommendations can be established. I suggest we should not spend much time with a legalistic review of what past recommendations have or have not said about complementary feeding, rather we should focus on the state of scientific knowledge - what do we know for sure, what seems likely, and what is simply still unknown. We will try to reach a consensus from a scientific point of view on what is best for the world's children in terms of feeding practices, for the immediate and long-term future.

Election of the presiding officers

B. Philippon proceeded with the election of the chair, vice-chair and rapporteurs for the meeting. The participants elected Dr A. Tomkins (UK) as chairman, Dr C. Victoria (Brazil) as vice-chairman Dr A. Ashworth (UK) and Dr K. Tontisirin (Thailand) as rapporteurs.
Session 1

1.1 The state-of-the-art review - description of the process. Definitions, malnutrition, physiological development and functional outcomes of child feeding practices

Presenter: K. Brown, University of California at Davis

As one step in a continually evolving process, the state-of-the-art document presents new insights into appropriate complementary feeding of infants and young children: the limited age window when growth faltering starts, the appropriate age of introduction of complementary foods, the energy density and frequency of feeding complementary foods and the importance of dietary quality.

The terminology used in this area was reviewed. Complementary foods are any foods that provide nutrients and that are given in addition to breast milk.1 “Special transitional foods” are specially prepared complementary foods, usually soft, pureed, or semi-solid, which are designed to meet the particular nutritional and physiological needs of the infant and young child, in addition to a continued intake of breast milk; thus there are two types of complementary foods, special transitional foods (often referred to as “weaning foods”) and family foods given to the child. In the document the specific sense of “weaning” is the complete cessation of breast-feeding. The term “weaning foods” should be avoided because it is a reference to the cessation of breast-feeding.

According to the child’s age, two theoretical patterns for energy intake could be considered: (1) the introduction of complementary foods displaces breast milk, i.e. decreases the amount of energy provided by breast milk or (2) the introduction of complementary foods has a minimal or no impact on the amount of breast milk. Research is needed in how complementary foods should be offered in order to maintain maximum breast milk intake.

Some issues were not examined in the document: non breast-fed infants, low-birth-weight and malnourished infants, and the dietary management of illness. Attention was given to the age of introduction of complementary foods, but the emphasis was on complementary foods themselves, their types and how they should be given, etc. Some topics deserve further development and will be inserted in the document:

- Renal maturation and solute load, and osmolality of complementary foods.
- Fat and essential fatty acid (EFA) contents of complementary foods.
- Food safety and processing will be condensed in a single section.
- Current intakes of foods and nutrients in developing countries.
- Programmatic interventions, i.e. existing programmes which have been correctly evaluated.

---

1 International Code of Marketing of Breast-milk Substitutes. Article 3. definitions:
For the purpose of this code:
“Breast-milk substitute” means any food being marketed or otherwise represented as partial or total replacement of breast milk, whether or not suitable for that purpose.
“Complementary food” means any food, whether manufactured or locally prepared, suitable as a complement to satisfy the nutritional requirements of the infant. Such food is also commonly called “weaning food” or “breast-milk supplement”.
Discussion

Several participants did not agree to changes in the terminology as this might be confusing and should only be done if there is a strong justification. Current interagency definitions should be used (they are given in Annex III). According to the WHO definition, "weaning" is a process starting with the introduction of complementary foods and ending with the complete cessation of breast-feeding. All participants agreed to avoid the term "weaning foods", but it was debated whether the term "special transitional foods" was needed or whether "complementary foods" was sufficient. Breast-milk substitutes are not regarded as complementary foods and were not discussed during the meeting.

Non-food factors, such as the mothers' status, her workload, the child's environment, etc, affect complementary feeding, and, therefore, should be taken into consideration.

1.2 Socioeconomic and cultural context of child feeding

Presenter: D. Alnwick

The UNICEF conceptual model of malnutrition served as the basis for this presentation. Three levels can be distinguished for the socioeconomic determinants of child feeding: (1) at the macroeconomic level, the issue of child rights is of crucial importance; (2) at the community level, a major point is quality of care for children; (3) at the household level, important issues include the autonomy of the care giver, alternative care givers and the care giver's workload whether paid or unpaid.

Education improves nutrition but the mechanisms of this effect have not been documented. It should be determined what basic education is needed to improve child feeding. Moreover some agreement should be found in this meeting on what is required of the care giver, e.g. minimum age, basic education on complementary feeding, etc. Child rights in terms of complementary feeding should be defined more precisely.

Discussion

Some experts felt that more time should be devoted to the complex social issues of child feeding, including anthropology, so as to balance the attention given to biological aspects in the state-of-the-art document. The role of the child in complementary feeding should be taken into account (e.g. interactions between the child and the care giver). The relationship between nutrition and income is weakest for children who are still breast-fed due to the protective effect of breast-feeding. An increase in income will not necessarily improve child feeding. One of the goals of the meeting is to find effective ways of improving complementary feeding without waiting for economic change to occur.

It was proposed to focus on key issues of complementary feeding in two types of situations: in the ideal situation, where there is knowledge, resources, proper sanitation, etc, and in the non-ideal situation. Guidelines for complementary feeding are needed even in the ideal situation. Constraints in non-ideal situations (e.g. poor sanitation) should be specified so that priorities can be set for these situations.

Targeted health and nutrition interventions can counterbalance the negative effects of structural adjustment on the poor. An example is given from Egypt: for working mothers, the present maternity leave of 3 months will be extended to 6 months. At the household level, studies have shown that the frequency of feeding infants and young children is high. In most families in Cairo, children under 2 years are fed family foods from 1 to 4 times per day. Children of working mothers have a better nutritional status than those of non-working mothers. A longitudinal study showed a positive
association between mothers’ education and the time they devoted to child care. Education can empower care givers for child feeding. Higher income is not always associated with better child feeding.

1.3 Breast-feeding, infant growth and the age of introduction of complementary foods

Presenter: K. Dewey, University of California at Davis (USA)

The physiological basis for breast-feeding was reviewed, particularly in the newborn period, during the first 4-6 months and after 12 months. In the newborn period, it is important to stimulate maximum breast milk output and to avoid nipple confusion. Until 4-6 months it is important to avoid the displacement of breast milk by fluids or foods of low nutritional quality, to reduce morbidity and mortality and to maximize bioavailability of nutrients. Beyond 12 months, breast milk is an important source of vitamin A, calcium and fat. It is especially important during illness as there is generally a reduction in intakes of complementary foods. Results of observational studies of the effect on appetite and growth are conflicting; continued breast-feeding at 1 year could be associated with a lower acceptance of complementary foods although reverse causation cannot be ruled out. Malnourished mothers should be supplemented. The long-term risks of breast-feeding, e.g. on heart disease, are very uncertain.

The theoretical considerations for determining the age of introduction of complementary foods were reviewed: there is a great plasticity of milk production to adapt to infant needs. When mothers are malnourished, however, there is no conclusive evidence as to whether milk production can be sustained as long as desired.

Whether exclusive breast-feeding is associated with growth faltering before 6 months is still debated for several reasons: the current growth reference is not relevant to breast-fed infants. In most studies, children were not truly exclusively breast-fed. The effect of low birth weight was usually not taken into account. Moreover growth patterns for weight and length differ and their determinants may be different. There are numerous limitations in observational studies, e.g. self-selection bias and confounding. There is a negative effect of complementary feeding on growth due to a higher incidence of diarrhoea.

There is only one experimental study, the Honduras trial: at 4 months, exclusively breast-fed children were randomly allocated to one of three groups: (1) exclusively breast-fed until 6 months, (2) receiving complementary foods from 4 months with ad-libitum nursing frequency, (3) receiving complementary foods from 4 months and maintaining previous nursing frequency. The complementary foods were safe and of adequate nutrient density. Total energy intake was slightly higher in children receiving solid foods, but there was displacement of breast milk by the complementary foods. In terms of increase in weight, there was no advantage of complementary feeding from 4 months. Although the foods were fortified with iron, they did not prevent iron deficiency anaemia in the complemented groups. There is a need for replication of this type of experiment in other settings, particularly in contexts where there is growth faltering and with infants of malnourished mothers.

The evidence presented suggests that full-term infants with appropriate weight for gestational age can be exclusively breast-fed until six months of age. Exclusive breast-feeding until 6 months is uncommon around the world. However, nutritional messages should be based on optimal feeding recommendations.
Invited comments

C. Victoria, Brazil

From a methodological standpoint, data on the effect of child feeding practices are subject to “effect-modification”. The socioeconomic status of the population is an example of effect-modification. Data from a study in Brazil, in which virtually no children were exclusively breast-fed illustrate this: in poor families, complemented infants grew better than predominantly breast-fed children from 5 months, while this occurred earlier, from 2 months, in rich families. Similarly, after 12 months, length differences between the breast-fed vs non-breast-fed children differed by income group.

Observational studies show conflicting results because of effect-modification. More discussion is needed in the state-of-the-art document of confounding (the effect can be distorted in either direction, negative or positive) and reverse causation (i.e. children growing poorly might be breast-fed longer, or might be given complementary foods earlier). Studies should not be rejected because of small sample size when they show significant effects. Even when the preliminary WHO growth reference data for breast-fed infants are used, some studies show that there is growth faltering in length from 0 to 2 months, and in weight from 4 to 5 months. There is an urgent need for replication of experimental studies such as the Honduran trial.

This commentator concluded that an age range for introduction of complementary foods is preferable to a fixed age because the impact on growth is sensitive to effect-modification, and so it is presently preferable to keep the current WHO recommendation of exclusive breast-feeding for 4 - 6 months. A new growth reference for breast-fed children is in the process of being developed. The focus of the meeting should be more on complementary foods rather than on the issue of the age of their introduction.

Discussion

Supplementation of lactating malnourished women, which was suggested to prevent maternal depletion, may be difficult in some countries such as India where supplementation of pregnant women is still not successful.

Several participants wished to spend more time on other important issues rather than on the timing of introduction of complementary foods for which there is not enough evidence to change the current recommendation. Moreover further discussion at the meeting will not resolve this issue. Given the paucity of evidence, participants suggested that the relevant section of the state-of-the-art document be reduced and the conclusion not be presented as definitive.

1.4 Duration of the need for special transitional foods

Presenter: K. Brown

The need for special transitional foods is dependent on the child’s neurological development. Skills of the newborn (sucking, munching, etc) and the type of foods infants and young children are able to ingest are described in relation to age. From 8 months, children can accept various types of foods, i.e. puréed and solid; the major issue is the time the child needs to eat the food, which differs according to the type of food. For a given type of food, the time to feed the child decreases with advancing age. Thus the period during which there is a need for special transitional foods is not only determined by the
physiological development of the child, but also by the time the care giver is willing to devote to child feeding.

Data from Peru show that, at 6 months of age, a majority of the children were consuming semi-solid foods (purees, etc), and one-third were consuming some solid foods. By the end of the first year most children consumed solid foods. Thus, at 12 months, most children are able to eat usual family foods.

One study has shown that feeding complementary foods can reduce the intake of breast milk at the same feeding, but did not affect total milk intake over a 24-hour period.

Invited comments

W. Moussa, Egypt

In Egypt, exclusively breast-fed children have a better anthropometric status. The time allocation of mothers was studied as part of an international collaborative project. For children between 18 and 30 months of age, mothers spent 30% of their time preparing food and feeding the child, including breast-feeding. Children are more often fed family foods than special transitional foods. Comparisons within families of energy and protein intakes of children and of other family members show that, in one-third of the families, the children’s needs were not met while the family’s needs were. It is necessary to educate families on infant’s and young children’s needs and on child feeding. Studies in rural communities have shown that foods prepared and given at home have a lower digestibility than foods prepared with commercial “weaning mixes”. In two-thirds of the families, the energy density of the child’s diet was lower than that of the family foods.

Discussion

Family foods can be used as transitional foods as long as they are mashed or pureed. In the Maghreb, soft mashed or pureed family foods were promoted for child feeding. Thus emphasis should not be put on distinguishing special foods from family foods as this might be used by the industry for marketing special foods.

Beyond the issue of consistency, the question of nutrient density needs to be addressed. The concern was expressed that, between the ages of 6 and 12 months, family foods might not be adequate to meet children’s needs.

The time needed for feeding is determined by the viscosity and the type of feeding. Another important factor is how active the care giver is in feeding the child (e.g. some children are left to eat by themselves); so there are two questions, namely the time needed by the child, and the time spent by the care giver to prepare the food and feed the child. These time and relational issues have important implications for interventions.

Session 2

The chairman proposed “Care”, i.e. the socioeconomic and cultural context of care in relation to complementary feeding, as the theme for a working group. Participants suggested that another group work on feeding modes at critical ages such as 9, 12 or 15 months. More research is needed on the
timing of the start of complementary feeding; it was proposed that a group work be established to identify methodological and other research questions for future studies.

2.1 Energy and nutrients needed from complementary foods: calculation of energy needed from complementary foods

**Presenter: K. Brown**

Breast milk intakes as well as breast milk composition are variable. There is a dilemma in using actual breast milk intakes because of the effect on breast milk intake of the introduction of complementary foods (i.e. displacement of breast milk). There is also some uncertainty about absorption by young children of nutrients from complementary foods. In the document, energy requirements used to calculate energy needed from complementary foods were those issued by the IDECG group (1996). They are based mainly on the measurement of total energy expenditure with the addition of energy required for growth.

Intakes of breast milk according to age and type of breast-feeding from developed and developing countries were reviewed. Estimates of mean energy intake from breast milk were derived from data on exclusively and almost exclusively breast-fed infants (i.e. receiving only water in addition to breast milk) until 5 months, and from all children, whether exclusively or partially breast-fed, thereafter. Energy provided by breast milk was subtracted from the requirement to obtain the energy needed from complementary foods.

**Discussion**

There are differences in total energy expenditure between countries (e.g. between Mexico and USA (Texas), in the range of 10% of expenditure. Total energy expenditure can change in response to manipulation of the diet (energy dense vs non-energy dense diets). There are still some methodological problems with the doubly labelled water technique (i.e. fractionation issues). There was a general, although not unanimous, view that the IDECG data were an advancement compared to the FAO/WHO/UNU requirements. Furthermore, choosing the lower requirements - i.e. from IDECG rather than FAO/WHO/UNU - provides more conservative estimates. K. Brown proposed inserting an annex in the document presenting the calculations based on the FAO/WHO/UNU requirements minus 5%. It was agreed that the issue would be clarified by presenting the various assumptions made and their differing implications in the calculations of nutrient requirements from complementary foods, using a sensitivity analysis.

2.2 Energy density, frequency of feeding and other factors affecting the intake of complementary foods

**Presenter: K. Brown**

Experimental studies from Peru of the impact on energy intake of varying energy densities and feeding frequencies were presented: energy intake increases as energy density or feeding frequency increase, but the effects are independent. An energy density near that of breast milk is sufficient to meet additional

---

energy requirements of the still-breast-fed infant with a feeding frequency of 3 per day. When the feeding frequency is higher than 3, the energy density can be lower than that of breast milk.

Energy intake is increased when high fat diets are given but the addition of oil to cereal pap can decrease the protein density considerably. Energy intake is higher with varied vs monotonous diets. When mothers report anorexia there is a mean 15% decrease in energy intake. The number of days of anorexia increases with age. Anorexia is an issue that deserves more attention.

Invited comments

A. Ashworth, UK

In the experimental studies presented, although energy intake increased with feeding frequency, the increment appeared to become progressively smaller (the increase in energy intake was 16% when frequency increased from 3 to 4 times per day, but was only 7% when frequency was increased from 4 to 5 times per day). Since feeding duration was not influenced by feeding frequency, the feasibility for mothers to feed very frequently should be borne in mind, with the expectation that there will be a maximum that mothers will tolerate. Although low energy densities can be compensated to some extent by increasing feeding frequency, we should consider what might be a realistic maximum.

Observations in Jamaica\(^1\) with non-wasted, non-breast-fed children (mean age 10.7 months, mean weight 6.7 kg) are not in accord with the data from Peru. Both studies provide data for children fed with the same frequency (4 feedings per day) with diets of comparable energy density. At both low and high energy densities, Jamaican children had lower energy intakes per kg of body weight than the Peruvian children (mean age 14.1 months, mean weight 7.0 kg). Children from Peru appeared to have a higher gastric capacity per kg of body weight (52 g/kg vs 35 g/kg for the Jamaican children). This difference may be because the Peruvian children were wasted, with malnutrition having differential effects on stomach capacity (relatively spared) compared with body weight (reduced). Thus values in Table 13 (Annex IV in this paper) of the state-of-the-art document (energy density of foods required to attain different total daily energy intakes at various feeding frequencies) may not be applicable to non-wasted children and caution should be exercised when using them for feeding recommendations. It was agreed that the results in Table 13 should be recalculated before being applied to non-malnourished children.

Invited comments

K. Tontisirin, Thailand

The programmatic approach to complementary feeding developed in Thailand for the last 15 years was described. In particular, issues of nutrient requirements and nutrient density were considered. A holistic approach was used.

It should be kept in mind that maternal malnutrition is a very important problem in Asia. In India, for example, the prevalence of low birth weight is 30-50%. In Thailand the prevalence decreased from 16% to less than 10%. Other consequences of maternal malnutrition are a poor micronutrient status of

---

newborns, and a low nutrient density of breast milk, particularly for vitamins A and B<sub>1</sub>. It was considered that breast milk provided an adequate supply of nutrients for up to 3-5 months only.

The programmatic approach was holistic, focusing on the promotion of antenatal care, breast-feeding, adequate complementary feeding, infection control, etc. For complementary feeding, the emphasis was on energy and protein needs. At the household and community levels, nutrient-rich foods were promoted. Until 6 months of age, complementary foods do not make a significant contribution to energy intake. From 6 months, the recommendation was to give one feeding per day consisting of rice with egg yolk, chicken liver or fish, and a green leafy vegetable. The energy density of the feeding was similar to that of breast milk, about 57 kcal/100 g. From 9 months, 2 feedings were recommended, and from 10 to 12 months, 3 feedings per day of the same energy density, with the continuation of breast-feeding. In a rural area, a gruel was formulated based on locally available foods (rice, sesame and groundnut). The energy density was approximately 450 kcal/100 g (powder) and 30-40 g were given per feeding in gruel form at 57 kcal/100 g of gruel.

Our experience shows that children’s needs can be met and proper growth achieved by breast-feeding and adequate complementary feeding based on nutrient dense foods, with a feeding frequency of 3-4 per day, which is acceptable to the population. In practice, the children’s growth performance can be used to judge the adequacy of child feeding. This programmatic approach successfully ensured an adequate nutrient density of complementary foods.

2.3. Introduction of the working groups

Several issues were proposed by the chairman as themes for the working groups and adopted by the participants:

- Aspects of "care" that are relevant to complementary feeding.
- Resource and environmental constraints on child feeding.
- Technical issues of energy density.
- Timing of the introduction of complementary foods, in particular research and methodological issues for future studies.

The working groups were asked to formulate conclusions in terms of feeding recommendations and research recommendations, as changes or additions to those proposed in the state-of-the-art document. The new propositions were to be discussed in plenary. The working groups convened.

Session 3

3.1 First report of the working groups

Rapporteurs from each working group summarized the group’s feeding and research recommendations, which were then discussed in plenary.

Working group 1
Resource and environmental constraints in complementary feeding

Two alternative approaches were suggested: firstly, the normative approach, i.e. making general recommendations, and, secondly, an approach in which the situation in the real world is examined and specific issues are addressed. An example was given of the latter approach: the issue of displacement
of breast milk by the introduction of complementary foods is not of great concern in an ideal situation. In contrast, in a non-ideal situation as in the developing world, this issue is of crucial importance. Post-partum amenorrhoea should be prolonged as much as possible and the protective effect of breast-feeding against infections should be maximized.

Feeding recommendations are largely determined by constraints that mothers face in situations such as food insecurity, poor hygiene, etc. Several questions were brought up by the working group, in particular how recommendations can be made for mothers who are subjected to these constraints. The group felt that more research was needed to form a basis for feeding recommendations. The following research recommendations were identified:

1. The effect of the introduction of complementary foods on the displacement of breast milk and maternal fertility - i.e. post-partum amenorrhoea - needs to be investigated, particularly in relation to the following:
   - age of introduction of complementary foods;
   - frequency of breast-feeding;
   - effect of demand on breast-feeding during the night;
   - whether the addition of fat to complementary foods affects satiety in such a way that the suckling stimulus and feeding frequency are altered.

2. Energy intake from complementary foods:
   - the issue of viscosity of gruel: research is needed at the household level on the actual intake of gruels and the acceptability of gruels of different viscosity for the child and the mother, in particular low-viscosity gruel (e.g. amylase-rich foods (ARF));
   - the texture of special transitional foods, in particular how it should change with the age of the child;
   - research is needed on foods the children can help themselves to;
   - research should be done to define the time period when a child can move from transitional foods to a full family diet, especially in situations where the family diet is not suitable because of bulkiness or when it contains spices.

3. Findings from biological efficacy studies should be followed by public health effectiveness studies before recommendations for implementation can be made. Public health effectiveness depends on the constraints the mother is facing. For example, time constraints when special foods should be prepared for the child, and constraints on the frequency of feedings where it is the custom to prepare food for the family only once a day.

4. Food safety should be separated from food processing. Moreover, issues of food safety need to be further developed in terms of the review of the literature and of research recommendations.

Discussion

The need for public health effectiveness studies was emphasized. Moreover, there are two important intermediate steps between the biological efficacy studies and the assessment of public health effectiveness, namely an adaptation process to the local situation and the social process of delivering recommendations to the population (including communication, message development, etc.). To date the scientific community has not given enough attention to the science of implementation.
Some participants felt that the goal of the meeting was to set recommendations at the biological level and that the subsequent steps of adaptation to local situations, etc. should be left to the regional or country levels. Other participants thought that recommendations for research of this nature can be given, which will contribute to reducing the time gap between the elaboration of biological recommendations and their translation into action. How this research will be carried out at the local level should be left to countries themselves.

To date there is not enough information to adapt feeding recommendations in situations where parasitism and other infections are prevalent, but it is strongly recommended that infection control be incorporated into nutrition programmes.

Participants did not agree to separating food safety and food processing because food safety is the goal of processing; nevertheless all agreed that food safety goes beyond processing.

Working group 2
Energy density of complementary foods

The group felt that not enough attention was given to the issue of viscosity in the recommendations of the state-of-the-art document. The existing literature is not conclusive as to the impact of modifying viscosity on energy intake and more research is needed in this area.

Data should be collected on the actual viscosity of foods currently given to children, and on opinions of care givers on the appropriate viscosity of complementary foods.

Research is needed on the impact of varying viscosities on energy intake, the time to feed the child and the ease of feeding in breast-fed non-malnourished children receiving foods of different energy densities in diverse settings.

Community trials are needed on the effect on intake of changing the viscosity of complementary foods and of the feasibility of change under field conditions.

The group agreed to meet again to formulate research and feeding recommendations.

Discussion

Some participants suggested that studies conducted in Africa, particularly in French-speaking countries, with the use of industrial amylase in complementary foods from small-scale producers should be incorporated in the state-of-the-art document. It was pointed out that different processes for reducing viscosity should be promoted for use by small-scale producers and in the household.

Given the constraints on the mothers' time, cup feeding should be investigated. It was stressed that studies of the effect of varying viscosities on energy intake should be performed in various populations. Moreover, the acceptability by the population of the reduction of viscosity should be evaluated.
Working group 3
Care issues in relation to complementary feeding

Care is a critical determinant of efficient child feeding practices. The group felt that the document did not reflect state-of-the-art knowledge on care. Two issues were raised: (1) what are the specific issues related to complementary feeding? (2) what issues need to be incorporated in the document?

The group proposed to include care related issues in an introductory chapter of the document, and to identify specific feeding and research recommendations related to care.

Two groups of factors can facilitate positive care giving:

- knowledge (e.g. subjective knowledge from past experience and information from sources such as the family and health workers), attitudes and perceptions, including motivation;
- characteristics of care givers (e.g. physical and mental health, time, autonomy in the control of resources and age).

Interventions to improve complementary feeding should take into account both sets of factors, including whether nutritional education is more efficient when coupled with actions to reduce care giver constraints.

Feeding behaviours and contexts need to be studied, e.g. where and how foods are offered, feeding style (whether feeding is active, if it is supervised, what the response of the care giver is to child behaviour), the frequency and timing of feeding over the day (whether there is a fixed schedule and how the care giver responds to cues of child hunger), child temperament and male involvement in child feeding.

Programmes should focus on conditions that are amenable to change. Characteristics operating at multiple levels should be considered (i.e. child related and care giver related, at household and at community level). In light of this multifaceted situation, a choice should be made as to which conditions can be acted upon.

The group agreed to meet again to discuss further specific feeding and research recommendations. A first research question is whether nutritional status can be improved by changing care-giving practices, which behaviours should be changed, and what impact can be expected from these changes.

Discussion

It was agreed that care had not been given enough attention in the document. There is a problem of definition; behavioural aspects should be considered as a part of care. Moreover, care issues should be considered throughout the document. There is a need to develop indicators of care. When programmes are implemented, care issues should not be dealt with sequentially, i.e. after the biological issues, but parallel to the biological aspects.

Working group 4
Timing of the Introduction of complementary foods

More research is needed in this area before definitive feeding recommendations can be made. Priorities for research were identified:
• Experimental trials are needed of the effect of the timing of introduction of complementary foods on outcomes such as anthropometry and micronutrient status in infants of normal birth weight in diverse settings. Follow-up of growth should extend beyond 6 months.
• Similar experimental trials are needed in low birth weight infants.
• The nutritional status of mothers should be taken into account in experimental trials, i.e. their anthropometry and/or micronutrient status. The effect of supplementation of the mothers could be tested using a four-cell experimental design.
• A new growth reference for breast-fed infants and young children is needed.
• The bioavailability of micronutrients from complementary foods should be studied.

The numerous difficulties of experimental trials with random allocation of infants to groups were discussed, e.g. analytical issues, monitoring of compliance, identification of stable populations, and differences between efficacy and effectiveness studies.

Discussion

New data on this issue are becoming available. Participants felt that there was not enough evidence to date to change the current feeding recommendations. Moreover, the goal of the meeting was not to propose new feeding recommendations but to review their scientific basis. One of the participants of the working group and the author of the section of the state-of-the-art document will rewrite the conclusion of the document on this topic. The group agreed to continue to work on identifying feeding and research recommendations.

3.2 Protein and micronutrient requirements from complementary foods of infants and young children up to 2 years of age. Defining problem nutrients and the capacity of locally available foods to provide feedings of adequate nutrient density

Presenter: L. Allen, University of California at Davis

The estimation of protein and micronutrient requirements from complementary foods is based on the total requirement minus the estimated nutrients provided by breast milk. The British Recommended Nutrient Intakes were used for most nutrients except protein (IDECG estimates were used), iron (FAO/WHO, 1988 which takes into consideration different levels of bioavailability of the diet), folate (FAO/WHO) and zinc (data from Krebs et al., and from Fomon). Amino-acid requirements were not considered.

Depending on the impact of maternal stores on breast milk composition, two groups of nutrients can be distinguished:

• Group I nutrients (e.g. vitamins A and B, selenium and iodine) for which a depletion of maternal stores causes a reduction in their breast milk content and is likely to adversely affect infant development.
• Group II nutrients (e.g. protein, calcium, vitamin D, iron, copper and zinc) for which maternal intake or deficiency has little impact on breast milk content. When the mother's intake is poor, there is a risk of maternal depletion.

The breast milk composition data used are from well nourished mothers and may be too conservative for nutrients of group I; this might lead to an underestimation of requirements from complementary foods for these nutrients.
The proportion of the total requirement that should be obtained from complementary foods was presented, assuming average breast milk intake: for vitamin A, most of the requirement is supplied by breast milk (4% is required from complementary foods at 6-8 months); in contrast, most of the iron and zinc requirement has to come from complementary foods (98% for iron at 6-8 months).

The required nutrient density of diets was calculated (i.e. the amount of nutrients per 100 kcal) and compared to the actual nutrient density of diets. The data on consumption used for this comparison were from Peru, the USA and Mexico (CRSP). Problem nutrients are those for which there is a discrepancy between desired and actual nutrient density. Based on these data, iron, zinc and calcium are problem nutrients, while vitamin A is not because the breast milk content is high.

“Candidate foods” are foods with a nutrient density adequate to supply the amount of nutrients needed within an energy limit of two-thirds of the total energy intake from complementary foods (i.e. the food has to provide enough nutrient while not supplying more than two-thirds of the energy requirement). For the period 6-8 months, within the energy limit of 180 kcal/day, only an intake of 136 g of chicken liver will supply the required amount of iron, that is 6.8 mg/day. It is very unlikely that a child will consume such an amount of liver every day. For vitamin A, as long as the child is consuming breast milk, there are numerous candidate foods (sources of vitamin A or precursors).

In most situations protein density will not be a limiting factor, especially if the child is consuming breast milk. In contrast, in the breast-fed child, it is almost impossible to meet iron needs from complementary foods, even with diets of high bioavailability. It might be difficult to meet zinc requirements, unless dried fish is consumed daily in significant amounts; calcium needs can be met if condensed milk is consumed. Vitamin A needs can be met, as long as breast milk intake is average, by supplying 1-50 g of many foods. Nevertheless when breast milk content is low, vitamin A requirements from complementary foods will be higher. Moreover, epidemiological data on the prevalence of vitamin A deficiency suggest that the bioavailability of carotenoids may be low. Research is needed in the following areas:

- To measure the impact of maternal supplementation on breast milk micronutrient content, in particular B vitamins.
- To measure the impact of complementary foods on the bioavailability of micronutrients from breast milk, in particular iron, zinc and carotenoids.
- To study the influence of maternal micronutrient stores on infant stores, particularly for iron.
- To identify ways to enhance the micronutrient status of young children (for iron, the consumption of animal products, fortified foods, the use of iron cooking pots).
- To conduct field trials to develop practical ways to implement approaches.
- To develop better functional indicators of micronutrient status in children.

Invited comments

R. Florentino, Philippines

The use of non-human milk is a major problem in developing countries. In the Philippines, the rate of mixed-feeding is 21.5% (with or without complementary foods). The rate of bottle-feeding is 17% at 0-3 months. Private companies, after the International Code of Marketing of Breast-milk Substitutes was implemented, produced so-called "follow-on formulas" and there is concern that these could be used as breast-milk substitutes.
Complementary foods are introduced too late, and in insufficient amounts and variety. They are based on thin cereal porridges, with the addition of the cooking water for vegetables (not the vegetables themselves). The amount of fish is too small. Banana is often added. Locally produced foods that have a good retail value, such as fruits, eggs and poultry, are usually not consumed by producers but sold for cash. Fats and oils are seldom used in complementary foods because they are believed to make digestion more difficult.

In developing countries, the bioavailability of important micronutrients e.g. iron, zinc and beta carotene, is low in complementary foods. The bioavailability of iron could be increased by including vitamin C-rich foods and adding some animal foods (fish and poultry).

The WINGS (Weaning Intervention through Growth Surveillance) project is a complementary feeding intervention within a growth surveillance project. Special foods are produced by mothers’ clubs (e.g. a mix based on ground rice and mung beans) and on a commercial basis through provincial processing centres (e.g. “Insumix”).

Discussion

It was pointed out that in developing countries, the health consequences of vitamin A deficiency are evident after 6 months including an increased mortality. Participants felt that it was not enough to rely on breast milk alone. Which strategy should be chosen, supplementation or complementation of mothers? In developing countries the breast milk content of vitamin A is much lower than in developed countries; nevertheless breast milk will provide more vitamin A than local foods. The bioavailability of carotenoids in complementary foods could be low and it was agreed that more research is needed in this area.

Several participants noted that there is an apparent paradox in the determination of the required nutrient density of complementary foods: for some nutrients (iron, zinc and calcium), the greater the breast milk intake, the higher the nutrient density of complementary foods should be! When breast milk intake is low, the required nutrient density for complementary foods can be lower. If the minimum nutrient density requirements cannot be found in foods, it will be necessary to fortify foods, or to supplement children.

Essential fatty acids were not considered in the state-of-the-art document although they are necessary for the prenatal and postnatal development of the child, in particular for brain development. It was agreed that they would be mentioned in the amended version. It was also noted that in the tables presented, iodine had been overlooked.

Iron is a major problem because the breast milk content of this nutrient declines dramatically with the child’s age. The concept that iron needs cannot be met through unfortified foods was challenged because it contradicts epidemiological data on anaemia prevalence. Based on this concept, all children should be anaemic or at least iron-deficient, while the actual prevalence of anaemia is approximately 50%. Moreover, the reference values for anaemia commonly used under 1 year of age may not be correct. Some of the data presented on the prevalence of anaemia and iron deficiency in breast-fed vs formula-fed infants at 3, 6 and 9 months illustrate this: the prevalence of anaemia was much higher than that of iron deficiency. An explanation for this discrepancy could be that some indicators of iron status are sensitive to infection (e.g. serum ferritin). The bioavailability in iron-deficient children could be higher than the values used for the calculations, which were based on data from iron-replete adults. The situation of vegetarian populations needs to be examined; for these populations, recommendations on the vitamin C content of complementary foods should be adapted. Some reservations were expressed as to whether this would be sufficient to meet iron needs. In countries where there are food processing units,
complementary foods should be fortified with iron (and possibly with other micronutrients), even at the level of small-scale production units. The bioavailability of this iron needs to be evaluated.

It was felt that there is still some imprecision with present recommended requirements, but the gap between requirements and what can be provided by complementary foods is nevertheless extremely large.

There are few quantitative data sets on actual diets with information on nutrient density and bioavailability. The authors of the state-of-the-art review asked participants to provide data sets from their countries.

Session 4

4.1 Food quality and processing

Presenter: P. Besangon, France

The quality of a food should meet the objectives of both safety and acceptability. This includes microbiological safety as well as the absence of toxic effects. The nutritional value plays an important role in terms of chemical composition and bioavailability of nutrients. The bioavailability of nutrients depends on their nature and on their physical and chemical environment; on the technological treatments that have been applied; on the presence of antinutritional factors and on nutrient composition. For instance, thermic processing, e.g. cooking, sterilisation and drying, may, depending on its intensity, increase nutritional value (increase the digestibility; inhibit the antinutritional factors) or damage nutrients, e.g. lysine may become partially unavailable.

Antinutritional factors are another cause of nutrient unavailability. Some are thermolabile (enzyme inhibitors, lectins) and thus inactivated by appropriate thermic treatments (heat sterilisation). Others are heat resistant (polyphenols, phytates). Phytates make phosphorus, as well as cations (calcium, iron) and protein unavailable. From this standpoint, strategies to improve the nutritional quality of foods may use endogenous enzymes (germination), fermentation processes, or industrially processed enzymatic preparations.

To conclude, food quality, i.e. safety and nutritional value, depend on the initial nutritional objective, the nutrient content and bioavailability, the presence or absence of antinutritional factors, and on the technological processes used.

Invited comments

W. Lorri, United Republic of Tanzania

Important issues were presented of food processing in developing countries. Diarrhoea is a major problem. Another issue of concern is the low bioavailability of micronutrients in foods.

There are four main factors that determine children's nutrient intake (I): a model was presented which summarized these factors and showed how they are interrelated. For interventions to be effective, all the factors should be taken into account. These factors are: the number of feedings per day (N), the amount of food eaten per feeding (Q), the nutrient density (D) and the bioavailability of the nutrient (A).

\[ I = N \times Q \times D \times A \]
In Tanzania, fermented cereal foods are traditionally used. Fermented foods inhibit the growth of *Shigella*. A prospective study in rural areas has shown that the incidence of diarrhoea was 40% lower in a village where children consumed fermented complementary foods compared with another village where only non-fermented foods were used. In developing countries several factors, such as lack of refrigeration, the mother’s workload, time constraints and the shortage of fuel, make it impossible for mothers to prepare fresh foods several times a day. The use of fermented complementary foods could be a valuable alternative to increased feeding frequency; the child could be fed several times from the same preparation.

Fermentation reduces the phytate content of foods and enhances the bioavailability of iron. But the bioavailability of iron remains low in foods with a high-tannin content, even when they are fermented. Thus the use of high-tannin foods for complementary feeding should be discouraged. When complementary foods are made from fortified cereals, the bioavailability of iron should be evaluated.

**Invited comments**

**R. Tannous, Lebanon**

Scientific knowledge and biological information should be “translated into foods”. The following issues should be addressed:

- Formulation of complementary foods (which raw ingredients should be used, whether they meet requirements).
- Nutritional evaluation of foods (through biological, human and animal studies), safety and absence of toxic compounds.
- Processing quality (ease of preparation, shelf life, microbiological qualities, ready-to-feed foods).
- Acceptability and tolerance.
- Economic feasibility.
- Marketing and distribution.

Important recommendations for the home preparation of foods are:

- Regarding viscosity: to avoid dilution.
- Regarding hygiene: to use potable water.
- To promote the use of iron-rich foods.
- To promote an appropriate timing of introduction of foods.

The involvement of mothers in decision-making is crucial.

**Discussion**

It is possible that high phytate levels protect plants from predators. Phytates could be important for plant nutrition, but cereal varieties with low phytate content have been successfully developed in the USA.

The question arose whether industrial amylase is safe. Several participants confirmed the safety and high quality of this product, which has been used in commercial baby-food preparations in developed countries for many years.
Low viscosity foods are interesting because the time needed to feed the child is shortened. The risks of ARF are microbiological contamination, increased osmolarity and presence of cyanide. It was noted that heating destroys cyanide. Risk/benefit equations should be studied, but if the benefit is not clear, risks are unacceptable. References to studies demonstrating low risks will be sent to the authors of the state-of-the-art paper for review. In India children consume twice as much food when they are given complementary foods enriched with ARF. The safety of these foods was acceptable.

Home processing of foods from the family pot is difficult with a fork. In Honduras the “happy-baby food grinder” provided an inexpensive solution to this problem.

Participants felt that the issue of allergens (milk protein and gluten) deserved more attention and that the relevant section of the state-of-the-art paper should be expanded (a drastic increase in the incidence of coeliac disease has recently been reported in some populations).

Session 5

5.1 Child feeding practices

Presenter: K. Dewey

The WHO Global Data Bank on Breast-feeding was cited, which uses a new set of indicators for breastfeeding practices at household and health facility levels (indicators and their definitions are presented in Annex IIIc).

5.2 Programmatic interventions to improve complementary feeding: a framework

Presenter: K. Brown

A conceptual framework was proposed to serve as a basis for classifying programmes that aim to improve complementary feeding. Although there is little information on programmes that have been evaluated, an attempt was made to show which strategies had had the most programmatic success.

There are two major types of interventions in terms of the external programme inputs. These inputs can be foods or nutrients in various forms, or nutrition education and communication. There are three levels of intervention: the central, community and home levels.

Centrally delivered strategies can take three forms:

- Preparation and distribution of a complete food mixture produced by a central public or private processing unit.
- Supplement, i.e. a mixture of micronutrients, or protein and micronutrients, that can be added to existing home-prepared food to enhance its nutritional value.
- Individual foods, either through a central distribution programme (e.g. a milk distribution programme to school children), food subsidies or a production strategy (e.g. home gardens).

The community interventions are basically a reduced version of the production and distribution of a complete food mixture.

At the household level, there can be three strategies:
Improving feeding practices and feeding behaviours (e.g. breast-feeding practices, the timing of introduction of complementary foods and feeding frequency).

- Specific interventions on complementary foods such as formulating recipes for home preparations.
- So-called “general nutrition concepts” for preparing foods, such as teaching mothers to mix a cereal and a legume source to improve the protein quality of the diet.

For each of these strategies, the type of external input varies. All strategies include an educational component, but the importance of this component varies; it is largest in the home-based strategies.

5.3 A review of some programmes that aim to improve complementary feeding practices through behaviour change

Invited comments

E. Piwoz, USA

The central question is which behaviours are amenable to change through carefully designed training and educational interventions. There are many examples around the world of programmes that have been successful at changing feeding and some care-related practices. Nonetheless there is a lack of documented studies and evaluations of the true impact on dietary intake, specifically the impact on breast milk intake, and whether the programmes were truly effective in complementing breast milk. The Dietary Management of Diarrhoea Project in Nigeria is the only programme where an attempt was made to measure this. With the exception of vitamin A, effects on the intake of micronutrients have generally not been assessed.

Some programme evaluations have measured anthropometric status. Others have had positive effects on child growth, i.e. children living in the programme area having better weight-for-age or weight-for-height than at baseline, or maintaining their nutritional status, while that of children living in areas outside the programme deteriorated. Programmes are generally less effective in terms of impact on length-for-age or height-for-age.

The rationale for programmes to improve child feeding practices through behavioural change is not to achieve optimal child feeding as this might be very difficult in many contexts. Convincing people to make small changes in feeding practices, if implemented regularly, could make a difference over time in child nutrition and growth.

It is interesting to examine the characteristics of successful nutrition behaviour-change programmes: they were developed locally with the active participation of the potential beneficiaries. The “triple A” UNICEF approach (Assessment, Analysis and Action) was used. There is an abundant literature on the methods of assessment and many instructional manuals also outline key feeding behaviours and caring issues at different ages. Implementation-related issues are equally important, i.e. the effectiveness of different approaches to training nutrition counsellors, how to enhance the effectiveness of supervision and ways to maximize behaviour change and ensure its sustainability.

Two recent reviews of programmes in Africa and in other regions have shown that mothers and other care givers are willing to change their complementary feeding practices, even in difficult environments, if they perceive positive benefits for themselves and their children. The practices that mothers were most willing to change varied according to the child’s age:

- Before 6 months: reducing the use of non-breast milk liquids.
- At 6-9 months: increasing the nutrient density of foods offered to the child and practising active feeding.
- At 9-12 months: increasing the variety of foods and snacks offered.
- At 12-23 months: increasing feeding frequency and supervision of feeding of children able to feed themselves.

Success in these areas is dependent not only on the educational message or the specific feeding recommendation, but also on the media used, the skills and endowments of the message providers, and on training, supervision and other structural considerations.

Some of the weaknesses and limitations of existing programmes were reviewed. The emphasis has been, with the exception of vitamin A, on increasing energy intake, and other aspects such as dietary quality have been overlooked. The impact on breast milk intakes has not been measured. Programmes have not adequately addressed the problem of improving feeding practices during convalescence and have not examined causes of anorexia and how to overcome it, nor have they always included food hygiene and safety considerations. Programme evaluations have seldom been published, and consequently, the lessons learned have not been shared.

Programmes have not examined whether behaviours are more likely to be improved for sustained periods by combining efforts to improve other caring factors such as women’s health, care giver time or psychosocial conditions.

This review was not exhaustive in terms of the programmes or strategies examined or of the many questions and problems such programmes generate, but these comments reflect some of the lessons learned with respect to programmes to improve complementary feeding through behavioural change.

**Discussion**

Participants who have data on national programmes or indicators at the national level were asked to make them available to the authors for review. For the choice and planning of interventions, both qualitative and quantitative approaches should be combined (with triangulation). The issue of targeting interventions was raised; it is more difficult to prevent stunting than to obtain improvements in stunted children. In Bangladesh, a programme of food distribution (sugar, milled beans, pre-gelatinized rice flour) targeted to stunted children was beneficial. Focusing interventions only on the poorest segment of the population may not be the best choice if the “less poor” segment is much larger. A strategy of fortification reaching 50% of the population would be seen as a considerable advance, and a more ambitious goal was not advocated.

There is a dearth of monitoring and evaluation. Assessing sustainability should be a major aspect of the evaluation of programmes. Several types of strategies were proposed and commented on. Quality control can be the limiting factor in interventions based on fortification (e.g. salt iodization). The determination of micronutrient composition of complementary foods should be a part of programmatic interventions (it has seldom been done). In community projects, marketing issues should be considered, e.g. shelf life of commercial foods, as well as the sustainability of strategies and financial issues. It was suggested that cost information be added in the framework presented by K. Brown.

A strategy based on the distribution of sachets containing amylase and micronutrients was mentioned. In addition to fortification and supplementation, other community-level strategies can be proposed such as changing food milling practices, making grinding mills accessible to the community, e.g. to make peanut butter, and promoting the production of nutrient-rich foods. Strategies based on weekly
supplementation should be investigated, while budget constraints at the national level should not be overlooked.

Social marketing was advocated; the crucial need for education and social mobilisation was reaffirmed. There is a limit to the number of messages that can be communicated (in the Bible there are only Ten Commandments!) and prioritisation is needed. Criteria for prioritisation should be developed; in Brazil, three criteria were used: prevalence of the inappropriate behaviour, expected impact of change and feasibility of change. The potential role of mothers’ support groups was cited. The “power flour” programme was mentioned as an example of how a confusing message can negatively affect a valuable intervention. Technical advice can be distorted; care should be taken to adapt to the local environment, and to support and participate in local decision-making.

**Recommendations**

Feeding and research recommendations identified and discussed by the working groups were presented in plenary and approved by the participants.
FEEDING RECOMMENDATIONS

Age of introduction of complementary foods

1. The working group concentrated its attention on complementary feeding from six months of age onwards. Time was insufficient for full discussion and analysis of the timing and duration for feeding of complementary foods prepared specially for infants. The group recommends further review and in-depth analysis of the subject to develop updated recommendations regarding the timing and duration for feeding complementary foods.

2. Attention to the nutritional status of lactating women is needed to ensure optimum breast milk nutrient levels, particularly for thiamin, riboflavin, vitamin B₁₂, vitamin A, iodine and selenium and to prevent maternal depletion.

Energy density and intake of complementary foods

3. The amount of energy required from complementary foods depends on the age of the child and the level of breast milk intake. Given current breast milk intakes in developing countries and an assumed breast milk energy content of 0.65 kcal/g, the average amount of energy required from complementary foods is tentatively set at 270, 450 and 750 kcal/day at ages 6-8, 9-11 and 12-23 months, respectively. These figures should be used as general guidelines of the range of energy required from complementary foods, but the best indicator of adequacy will be the infant’s growth.

4. During infancy the consistency of complementary foods is of special concern in most populations. By the end of the first year, infants should be receiving mashed or chopped foods.

5. Appropriate feeding frequency depends on the energy density of complementary foods and vice versa. Based on theoretical calculations of gastric capacity, the minimum energy density of complementary foods to satisfy energy requirements at 1, 2, 3 and 4 meals/day are:

<table>
<thead>
<tr>
<th>Age range (mo)</th>
<th>1 meal</th>
<th>2 meals</th>
<th>3 meals</th>
<th>4 meals</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8</td>
<td>1.08</td>
<td>0.54</td>
<td>0.36</td>
<td>0.27</td>
</tr>
<tr>
<td>9-11</td>
<td>1.58</td>
<td>0.79</td>
<td>0.53</td>
<td>0.40</td>
</tr>
<tr>
<td>12-23</td>
<td>2.16</td>
<td>1.08</td>
<td>0.72</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Empirical data from non-breast-fed malnourished infants indicate that greater energy intakes occur with each additional meal, regardless of energy density, but there may be diminishing returns in that, as the number of meals increases, the increment in total energy intake may be progressively less. There is a limit beyond which feeding frequency cannot compensate for low energy density.
6. Low energy density often coexists with low nutrient density. Modifications to increase energy
density such as adding fats or sugar should also take into account the potential adverse impact on protein
and micronutrient density.

7. Flavour, aroma, consistency and variety may affect the intake of complementary foods. Amylase
treatment can enable high energy and nutrient densities to be achieved at low viscosity. In some settings,
viscosity reduction of diets of the same energy density has resulted in greater energy intakes, whereas
in other settings no increase has been found.

8. The order in which complementary foods are fed to breast-fed infants, i.e. before or after nursing,
does not appear to have much influence on short-term daily energy intake.

Nutrient density

9. Assuming that the consumption of breast milk is average (Annex V, Table 9 of the state-of-the-art
document), the protein density (g/kcal) of complementary foods is not likely to be a limiting factor in
most populations. This generalization may not hold where complementary foods are based on low-
protein staples, such as sweet potatoes or cassava. Although amino-acid requirements from
complementary foods were not dealt with in this report, they should be considered in future reports.

10. Breast milk meets the essential fatty acid (EFA) requirements of exclusively breast-fed infants.
As the proportion of complementary foods gradually increases, care should be taken to ensure that the
diet contains enough EFA to meet requirements and enough fat to facilitate the absorption of fat-soluble
vitamins.

Micronutrients

11. Meeting micronutrient needs from complementary foods appears to be the greatest challenge.
Based on the calculations on protein and micronutrients in the state-of-the-art document, adequate
amounts of certain key nutrients (iron, zinc, calcium in particular) can only be met if animal products
are consumed in quantities unlikely to be feasible. Thus, alternative strategies need to be considered.
The estimates of micronutrient density in complementary foods are based on requirements when breast
milk intake is average (Annex V-Table 11 in the State-of-the-art paper). It should be kept in mind that
estimates are based on theoretical calculations that may be amended by further empirical research.

11.1 Iron

It is practically impossible to supply iron from unmodified complementary foods to meet calculated
needs at 6-11 months of age without unrealistically high intakes of animal products (with the possible
exception of dried fish powder). Key iron-rich foods are liver, fish and beef; eggs are also high in iron
but its bioavailability is questionable. The quantities of these foods that would be needed to meet
estimated iron needs are generally much higher than currently observed maximum intakes prior to 12
months in the few studies for which quantitative data are available. If estimated requirements are correct
(this requires further research), other means of providing iron at this age are needed (such as fortification
of complementary foods or supplementation). After the first year of life, it is theoretically possible to
meet calculated iron needs from foods such as 60-80 g/day of liver, but the practicality of this in most
populations is questionable.
11.2 Zinc

It is also very difficult to meet calculated zinc needs from unmodified foods at 6-8 months of age, unless there is a high intake (totalling 50-70 g/day) of liver, dried fish, cheese, dry milk powder or beef. At 9-23 months, calculated zinc requirements can be met by relatively high intakes of liver, cheese, fish, dry milk powder, beef, egg or chicken (50-200 g/day). Again, the practicality of such intakes of animal foods in many populations is questionable.

11.3 Calcium

Calcium needs can be met if sufficient amounts of milk products or fish, including bones, are consumed, approximately 20-30 g/day of dry milk powder or dried fish at 6-11 months, and 12-15 g at 12-24 months. Use of non-human milk during infancy is not usually recommended for breast-fed infants because of the risks of displacement of breast milk, microbial contamination, particularly if bottles are used, and gastrointestinal blood loss when fresh milk is consumed. However, when milk is available and is the most accessible source of these nutrients, it should be boiled and preferably incorporated during cooking.

11.4 Vitamin A

For children whose mothers have normal breast milk vitamin concentration (at least 50 μg/l), vitamin A needs can be met by appropriate selection of complementary foods. The amounts of these foods required are not large (generally 1-50 g/day); however, further information is needed concerning the bioavailability of vitamin A precursors from vegetables and fruits. Where palm oil or other local food sources of precursor carotenoids are available, vitamin A needs can be readily met.

In areas of endemic vitamin A deficiency, improved provitamin and vitamin A intakes of the mothers and/or greater intakes of vitamin A-rich complementary foods by their children is advisable. Vitamin A supplementation of mothers and/or their infants with an appropriate timing and dosage is a suitable alternative.

Food processing and safety

12. Foods may be contaminated by heavy metals, pesticides and drug residues. Some foods contain antinutritional factors. Fortunately most of these are heat labile. Bacterial contamination of cooked foods may occur, particularly if stored at ambient temperatures. Traditional lactic acid fermentations of cooked foods may occur, particularly if stored at ambient temperatures. Traditional lactic acid fermentations inhibit the growth of certain pathogenic microorganisms, including Shigella and Escherichia coli, and remove some antinutritional factors. Food processing may enhance nutrient bioavailability. Appropriate processing techniques should be chosen depending on the types of foods and available resources.

---

1 See Fermentation: Assessment and Research, Report of a Joint FAO/WHO Workshop on fermentation as a household technology to improve food safety (WHO/FN/96.1).
Issues related to care-giving

13. Interventions to improve complementary feeding practices should include consideration of feeding style and child characteristics, as they may influence the types and amounts of complementary foods consumed by young children.

14. Poor appetite is a common phenomenon and can have a large impact on total energy intake. It is therefore important to provide care givers with a variety of strategies for overcoming poor appetite.

15. Feeding recommendations that address intake during and after illness need to be included whenever complementary feeding guidelines are developed. Care givers should be supported in their effort to feed children effectively during illness and convalescence.
RESEARCH RECOMMENDATIONS

Age of introduction of complementary foods

1. Research on whether displacement of breast milk is greater with certain foods or fluids, or when such items are given by bottle rather than by other means, would be helpful in understanding (a) the risks of early complementary feeding and (b) the best way to maximize breast milk intake once other foods have been introduced at the appropriate age.

2. Evidence suggests that continued breast-feeding beyond 12 months is advantageous to infant health. Further information is needed about poor appetite and growth in some breast-fed children, and the relationship of infant feeding to morbidity and mortality in different environments during the second year of life. Rigorously designed longitudinal studies that can rule out confounding variables and reverse causation are needed to resolve these issues.

3. There is a need for well-designed intervention trials to determine the effects of maternal nutritional status, dietary intake and breast-feeding management (i.e. frequency of breast-feeds and feeding to satiety at the breast) on breast milk volume and composition, particularly the fat and micronutrient content throughout lactation.

4. Randomized experimental efficacy trials in diverse settings are needed to assess the impact of age of introduction of complementary foods on full-term, appropriate-for-gestational-age infants. Anthropometric and other outcomes (e.g. micronutrient status, morbidity and mortality) should be assessed. Similar trials are needed in preterm and low-birth-weight term infants, and when maternal nutritional status is poor as reflected by anthropometry and micronutrient status.

5. The group reaffirmed the need for a new growth reference based on infants fed according to the feeding recommendations of WHO.

Energy density and viscosity

6. Studies in various settings are needed on the relation between energy density of complementary foods, frequency of feeding, total daily energy intake, and breast milk consumption.

7. A better understanding is required of the optimal level of energy intake from fat sources where total daily energy intake and intake of protein and micronutrients are concerned.

8. The causes of poor appetite should be examined in different settings, and controlled intervention trials should be conducted to identify effective methods to reduce the prevalence of poor appetite. The relation between dietary diversity and total energy intake should be examined. Other dietary factors that influence total intake of both complementary foods and breast milk should be explored.

9. The duration of need for special complementary foods should be studied by examining food intake by type of food and food preparations for children of different ages in different locations. The time required to feed different types of preparations should also be measured.
10. The viscosity of traditional gruels and other foods, in selected environments and representative households, should be measured for children of different ages (6-24 m), with reference to the following:

- ingredients used;
- accurate description of process;
- mode of feeding;
- measurement of viscosity;
- estimation of nutritional value, especially of micronutrients on a dry weight basis.

Information is needed on the preferred viscosity of complementary foods for young children of different ages in a variety of national settings.

11. The effect of different viscosities on total intake of complementary foods and energy, as well as the time required for feeding, needs to be investigated for children 6 to 24 months of age in different populations and environments, in relation to various levels of energy density.

12. Community-based intervention trials with reduced-viscosity foods are needed.

13. Further studies are needed on the effects of food monotony and variety on energy intakes in various environments.

14. Methods used for measuring viscosity should be standardised by:

- comparing results given by different types of rotary viscometers, and different measuring systems for each type of viscometer, with selection of the best parameter to measure viscosity;
- validation of new methods used for estimating consistency in the field (such as the Flow Box).

15. Further studies are needed on the methods of reducing viscosity at home using different sources of amylase (ARF, etc.), and at cottage-industry level using commercial amylases.

16. Studies are needed on improvement of bioavailability of nutrients by using enzymes, fermentation and other food processing techniques.

17. Effects should be evaluated of different processes on safety, nutritional value and functional or organoleptic properties of complementary foods as affected by:

- roasting/toasting leguminous seeds;
- cooking of gruels on the vitamin content of vitamin-enriched foods;
- storage methods and packaging in polyethylene bags;
- sun drying.

18. Additional proposals for future research include evaluating the consequences of the introduction of new foods or new processes on the physiology of the digestive tract, the microbial population in the intestine, the availability of energy, the need for fibres (level, nature), and the allergenicity of processed foods.

19. Studies are needed to assess the nutrient bioavailability of complementary foods and the impact of complementary foods on the bioavailability of nutrients in human milk.
20. Additional research is needed to examine the impact of varying the order of presentation of complementary foods (e.g. before or after breast-feeding) on 24-hour breast milk intake and on total long-term intakes.

**Nutrient intake and bioavailability from complementary foods**

21. Different ways of ensuring adequate intakes of macronutrients and micronutrients from locally available complementary foods should be explored in a variety of settings. This should include exploring the potential for increased use of animal products and local food-processing techniques. Research to identify and assess new sources of essential nutrients is needed. Other possible approaches to achieving adequate intakes include use of fortified foods, micronutrient supplements or adding micronutrients to existing diets.

22. After determining the efficacy of the aforementioned approaches, field trials should be conducted to develop practical methods to implement and evaluate these recommendations. Specific indicators of interest include energy and nutrient intakes by food source (including breast milk), physical growth, morbidity, micronutrient status and behavioural development.

23. Research is needed on the normal physiological changes in iron-status indicators during the first year of life to permit adequate assessment of iron status. Ideally, this would include sensitivity and specificity analyses of various cut-offs for identification of iron deficiency and iron deficiency anaemia, and functional correlates of these indicators.

24. Comparative studies of the effectiveness of different strategies to prevent iron deficiency during infancy should be conducted. These might include (a) preconception and prenatal interventions to improve maternal iron status and prevent low birth weight; (b) changes in obstetric practices related to timing of umbilical cord clamping; (c) iron-fortified complementary foods; (d) new approaches to enhance intake of dietary iron or improve its absorption; and (e) oral iron supplementation. Examples include increasing consumption of haem iron, intake of metallic iron (from cooking pots or drinking water), decreasing consumption of inhibitors (low-phytate foods or food processing techniques to reduce the content of phytate, polyphenols, etc.) or increasing consumption of facilitators of iron absorption (e.g. ascorbic acid-containing foods). Similar efforts are required with respect to other micronutrients including vitamin A and zinc.

25. Better indicators of the status of other micronutrients and their interpretation need to be developed for infants and young children.

26. The benefits of multiple micronutrient interventions should be assessed in different settings. Attention should be given to assessing the degree of benefit achieved with low, graded levels of intake within interventions.

27. To coordinate these research efforts, networking is needed to share information on complementary food composition, evaluation of local complementary food alternatives, and assessment of effective activities related to promoting adequate complementary feeding.

**Research questions relating to care**

28. Studies are needed to investigate whether the improvement of feeding style can increase the intake of complementary foods.
29. Research is needed to assess whether interventions to improve the care-giving environment have an additive or synergistic effect when combined with interventions to improve complementary feeding practices.

30. Studies are needed to determine whether food intake can be increased through behavioural strategies for increasing child interest and ingestion of complementary foods, such as offering variation in taste or texture, and providing appropriate opportunities for self-feeding and finger foods.

31. There is a need for improved understanding of how economic and intra-household processes and women’s roles influence the availability of complementary food for young children.
**AGENDA**

**Joint WHO/UNICEF Consultation on Complementary Feeding**  
28-30 November 1995  
Montpellier, France

**Tuesday, 28 November 1995**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>09h00</td>
<td></td>
<td>Welcome - B. Philippon, Head, Department of Health, ORSTOM</td>
</tr>
<tr>
<td>09h10</td>
<td></td>
<td>Introductory remarks, objectives and expected outcomes, R. Saadeh, WHO and D. Alnwick, UNICEF. Information on other initiatives underway: WHO Global Data Bank on Breastfeeding, R. Saadeh, WHO working group on infant growth, M. de Onis, WHO</td>
</tr>
<tr>
<td>09h40</td>
<td></td>
<td>Designation of the Chair, Vice-chair and rapporteur</td>
</tr>
<tr>
<td>09h50</td>
<td></td>
<td>Discussion, comments, recommendations for any modifications to agenda or procedure</td>
</tr>
<tr>
<td>10h00</td>
<td><strong>Session 1</strong></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td></td>
<td>Definitions, malnutrition, physiological development and functional outcomes of child feeding practices, K. Brown</td>
</tr>
<tr>
<td>10h10</td>
<td></td>
<td>Discussion</td>
</tr>
<tr>
<td>10h20</td>
<td>1.2</td>
<td>Socioeconomic and cultural context of child feeding, D. Alnwick</td>
</tr>
<tr>
<td>10h30</td>
<td></td>
<td>Discussion</td>
</tr>
<tr>
<td>10h40</td>
<td>1.3</td>
<td>Breast-feeding, infant growth and the age of introduction of complementary foods, K. Dewey</td>
</tr>
<tr>
<td>10h55</td>
<td></td>
<td>Comment, C. Victora</td>
</tr>
<tr>
<td>11h05</td>
<td><strong>Break</strong></td>
<td></td>
</tr>
<tr>
<td>11h25</td>
<td></td>
<td>Discussion, conclusions</td>
</tr>
<tr>
<td>11h50</td>
<td>1.4</td>
<td>Duration of the need for special transitional foods, K. Brown</td>
</tr>
<tr>
<td>12h00</td>
<td></td>
<td>Comment, W. Moussa</td>
</tr>
<tr>
<td>12h10</td>
<td></td>
<td>Discussion, conclusions</td>
</tr>
</tbody>
</table>
13h00 Lunch

14h15 Session 2

21 and 2.2 Energy and nutrient requirements from complementary foods. Feeding frequency, energy density and other factors affecting intake of complementary foods, K. Brown

14h45 Comment, A. Ashworth

14h55 Comment, K. Tontisirin

15h05 Discussion

15h30 Break

15h50 2.3 Chairperson to sum up progress so far, formation of required working groups

16h00 Working groups to convene as needed to pursue issues presented which require further discussion

17h45 Close

Wednesday, 29 November 1995

09h00 Session 3

3.1 Reports from working groups which convened on Tuesday

09h30 Chairperson - consensus reached so far - areas flagged for more discussion, or needing more research

09h50 3.2 Protein and micronutrient requirements from complementary foods. Defining problem nutrients and ability of locally available foods to provide meals with adequate nutrient density, L. Allen

10h20 Comment, R. Florentino

10h30 Discussion

11h00 Break

11h20 Discussion

12h45 Chairperson to sum up progress so far, formation of required working groups

13h00 Lunch

14h15 Session 4
4.1 Food qualities and processing, P. Besançon

14h35 Comment, W. Lorri
14h45 Comment, R. Tannous
14h55 Discussion
15h30 Break
15h50 Chairperson to sum up progress so far, formation of required working groups
16h00 Working groups convene
17h30 Close

Thursday, 30 November 1995

09h00 Session 5 Working groups (continued)
10h00 5.1 Child feeding practices, K. Dewey
11h00 Break
11h20 Review of workshop progress (rapporteurs)
12h20 5.2 Programmatic interventions to improve complementary feeding, K. Brown
12h30 5.3 Comments, E. Piwoz
12h40 Discussion
13h00 Lunch
14h14
15h30 Break
15h50 Feeding and research recommendations
16h30 General discussion, next steps
17h00 Conclusions, next steps, process of producing report. Preparation for regional meetings which will seek to use the outcomes of this meeting to develop practical guidelines and programmes to improve complementary feeding
17h30 End of workshop
19h00 Meeting of steering group
1. Interventions to prevent and significantly reduce malnutrition of children in developing countries for many years have focused on children aged 0-5 years. There is, however, a growing consensus that the greatest nutritional threat to children occurs in the period from about 6 to about 24 months of age. Infectious disease rates, particularly that of diarrhoea, peak during this period, and the process of growth failure begins, with stunting often persisting throughout childhood.

2. Malnutrition in infants and young children is the result of a complex of societal, household and individual factors. Access by all family members to nutritionally adequate and safe food, availability and use of health services and a sound environment are important underlying factors that have been the focus of numerous field interventions for improving the nutritional status of children. It is increasingly clear, however, that a greater reduction in childhood malnutrition can be achieved in many settings by improving the care provided to those in the highly vulnerable 6-24 month age-group, particularly where feeding practices are concerned. Studies suggest that caring practices and feeding behaviour have significant effects on child growth.

3. By about six months of age all infants should be receiving appropriate complementary foods, and breast-feeding should continue for up to two years of age or beyond. The period of complementary feeding should begin when breast milk alone no longer satisfies the nutritional requirements of the infant. Numerous studies demonstrate that inappropriate complementary feeding practices - including premature or late introduction of foods other than breast milk, inadequate amounts of nutritionally adequate and safe food, and early cessation of breast-feeding - are important determinants of malnutrition among young children.

4. A wide range of interventions is supported by governments, international development agencies and nongovernmental groups to improve complementary feeding practices. These are frequently based on locally available foods, whether prepared in the home or through large-scale production and marketing schemes. Nevertheless, many of these interventions have a weak scientific base. Indeed, answers to a number of fundamental questions about appropriate complementary feeding are urgently needed as a basis for reducing malnutrition by increasing the impact of existing interventions and developing new ones. Among the many questions requiring careful consideration are the following:

4.1 optimal timing of introduction of complementary foods, including development of indicators that families can easily use to determine when to begin providing foods in addition to breast milk;

4.2 optimal composition of complementary foods, including special attention to micronutrient content and energy density, food components that may inhibit the bioavailability of certain nutrients and techniques that minimise contamination by microorganisms;

4.3 appropriate feeding frequency, amount of foods to be fed, and type of feeding utensils;

4.4 the relationship between complementary feeding behaviour and sustained breast-feeding, and ways to achieve optimal breast-feeding frequency and duration;
4. 5. the relationship between maternal health and nutritional status, breast-feeding patterns and complementary feeding practices;

4. 6. common social, cultural and economic constraints to optimal complementary feeding practices.

5. WHO and UNICEF have begun an initiative to address the need for programme-oriented research in this important area. The two organizations, assisted by others, are collaborating with the University of California at Davis in preparing a state-of-the-art review of existing information on complementary feeding, which should be completed by June 1995. A technical consultation of qualified experts is expected to take place in September 1995 to reach consensus on (a) suitable programmatic recommendations based on existing information, and (b) a practical, action-oriented research agenda to deal with priority issues that will help ensure optimal child feeding practices. A small steering committee, composed initially of WHO, UNICEF and the nutrition research community, will guide this process while spearheading the fund-raising effort to support the applied research agenda.

6. An important product of this initiative will be scientifically sound guidelines for use by field practitioners in planning and implementing activities to improve child feeding practices, thereby reducing child malnutrition and related morbidity and mortality. An important body of research with extensive practical applicability for future nutrition interventions will be generated as a result.
WHO Global Data Bank on Breast-feeding

The WHO Global Data Bank on Breast-feeding is maintained at the Programme of Nutrition of the World Health Organization in Geneva. The Programme of Nutrition has finalized the Bank’s restructuring in line with the new breast-feeding indicators and definitions, which were developed to broaden the nomenclature for describing different types of breast-feeding behaviour and to increase the coherence, reliability and comparability of data.

The Bank pools information from national and regional surveys and studies dealing specifically with breast-feeding prevalence and duration. Every effort is made to achieve worldwide coverage which will permit:

- comparisons between countries and regions, and within the countries;
- assessment of breast-feeding trends and practices as a basis for future action;
- monitoring of breast-feeding prevalence and trends, and analysis of trends over time;
- evaluation of the impact of breast-feeding promotion programmes;
- ready access to current data for use by policy- and decision-makers, scientists, researchers, hospital administrators, health workers, and other interested parties.

To achieve these objectives it is necessary that current breast-feeding indicators and definitions be disseminated worldwide and that researchers and health professionals supply data to the Bank in order to keep it up-to-date. Both conditions have to be fulfilled if the WHO Global Data Bank on Breast-feeding is to achieve its full potential and thereby contribute to the health of mothers and infants everywhere.

To this end, a report will be prepared every two or three years on breast-feeding trends in countries for which data are available. It is hoped that this will enable responsible authorities in countries to achieve the breast-feeding goals they have established, while it serves to motivate all concerned to strengthen breast-feeding support programmes.
Table 1: Exclusive breast-feeding and median duration of breast-feeding: a global and regional overview, 1996

<table>
<thead>
<tr>
<th>WHO region</th>
<th>Total No. of infants (millions)</th>
<th>Total No. of countries</th>
<th>Countries of the region includeda</th>
<th>Infants in the region includedb</th>
<th>Exclusive breast-feeding rate &lt; 4 months of agec</th>
<th>Median duration of breast-feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>23.3</td>
<td>46</td>
<td>25</td>
<td>54</td>
<td>71</td>
<td>19</td>
</tr>
<tr>
<td>The Americas</td>
<td>16.0</td>
<td>35</td>
<td>14</td>
<td>40</td>
<td>38</td>
<td>34</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>42.2</td>
<td>10</td>
<td>6</td>
<td>50</td>
<td>93</td>
<td>49</td>
</tr>
<tr>
<td>Europe</td>
<td>11.5</td>
<td>50</td>
<td>4</td>
<td>8</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>15.5</td>
<td>22</td>
<td>11</td>
<td>50</td>
<td>84</td>
<td>36</td>
</tr>
<tr>
<td>Western-Pacific</td>
<td>28.7</td>
<td>27</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>33</td>
</tr>
<tr>
<td>World total</td>
<td>137.2</td>
<td>190</td>
<td>61</td>
<td>32</td>
<td>58</td>
<td>35</td>
</tr>
</tbody>
</table>

Source: WHO Global Data Bank on Breast-feeding

- Includes countries for which nationally representative data are available.
- Percentage of children less than one year of age by region for which nationally representative data are available.
- Percentage of infants under four months of age whose sole source of nourishment is breast milk.
## WHO GLOBAL DATA BANK ON BREAST-FEEDING

### BREAST-FEEDING INDICATORS DERIVED FROM HOUSEHOLDS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever breast-fed rate</td>
<td>Infants less than 12 months of age who were ever breast-fed</td>
</tr>
<tr>
<td>Mean duration of breast-feeding</td>
<td>Average duration of breast-feeding in months</td>
</tr>
<tr>
<td>Median duration of breast-feeding</td>
<td>Age in months when 50% of children are no longer breast-fed</td>
</tr>
<tr>
<td>Exclusive breast-feeding rate at 1 month</td>
<td>Infants at 1 month of age who are exclusively breast-fed</td>
</tr>
<tr>
<td>Exclusive breast-feeding rate at 2 months</td>
<td>Infants at 2 months of age who are exclusively breast-fed</td>
</tr>
<tr>
<td>Exclusive breast-feeding rate at 3 months</td>
<td>Infants at 3 months of age who are exclusively breast-fed</td>
</tr>
<tr>
<td>Exclusive breast-feeding rate at 4 months</td>
<td>Infants at 4 months of age who are exclusively breast-fed</td>
</tr>
<tr>
<td>Exclusive breast-feeding rate at 5 months</td>
<td>Infants at 5 months of age who are exclusively breast-fed</td>
</tr>
<tr>
<td>Exclusive breast-feeding rate at 6 months</td>
<td>Infants at 6 months of age who are exclusively breast-fed</td>
</tr>
<tr>
<td>Exclusive breast-feeding rate &lt; 4 months</td>
<td>Infants less than 4 months of age who were exclusively breast-fed in the last 24 hours</td>
</tr>
<tr>
<td>Predominant breast-feeding rate</td>
<td>Infants less than 4 months of age who were predominantly breast-fed in the last 24 hours</td>
</tr>
<tr>
<td>Timely complementary feeding rate</td>
<td>Infants 6-9 months of age who received complementary foods in addition to breast milk in the last 24 hours</td>
</tr>
<tr>
<td>Continued breast-feeding rate (1 year)</td>
<td>Children 12-15 months of age who were breast-fed in the last 24 hours</td>
</tr>
<tr>
<td>Continued breast-feeding rate (2 years)</td>
<td>Children 20-23 months of age who were breast-fed in the last 24 hours</td>
</tr>
<tr>
<td>Bottle-feeding rate</td>
<td>Infants less than 12 months of age who are receiving any food or drink from a bottle</td>
</tr>
</tbody>
</table>
## WHO GLOBAL DATA BANK ON BREAST-FEEDING

### INDICATORS FOR ASSESSING HEALTH FACILITY PRACTICES THAT AFFECT BREAST-FEEDING

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusively breast-fed by natural mother rate</td>
<td>Percentage of infants exclusively breast-fed by their natural mothers from birth to discharge</td>
</tr>
<tr>
<td>Breast-milk substitutes and supplies receipt rate</td>
<td>Percentage of mothers who received breast-milk substitutes, infant feeding bottles or teats at any time prior to discharge or during a prenatal visit to the health care facility</td>
</tr>
<tr>
<td>Rooming-in rate</td>
<td>Percentage of infants rooming-in 24 hours a day, beginning within 1 hour of birth, not separated from the mother for more than 1 hour at any time</td>
</tr>
<tr>
<td>Breast-fed rate</td>
<td>Percentage of infants breast-feeding in the 24 hours prior to discharge</td>
</tr>
<tr>
<td>Timely first-suckling rate</td>
<td>Percentage of infants who first sucked within 1 hour of birth</td>
</tr>
<tr>
<td>Exclusively breast milk fed rate</td>
<td>Percentage of infants exclusively breast milk fed from birth to discharge</td>
</tr>
<tr>
<td>Bottle-fed rate</td>
<td>Percentage of infants receiving any food or drink from a bottle in the 24 hours prior to discharge</td>
</tr>
<tr>
<td>Pacifier use rate</td>
<td>Percentage of infants who received pacifiers at any time prior to discharge</td>
</tr>
</tbody>
</table>
# Definitions Used in the WHO Global Data Bank on Breast-Feeding

<table>
<thead>
<tr>
<th>Category of Infant Feeding</th>
<th>Requires that the Infant Receive</th>
<th>Allows the Infant to Receive</th>
<th>Does not Allow the Infant to Receive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive breast-feeding</td>
<td>Breast milk (including milk expressed or from wet-nurse)</td>
<td>Drops, syrups (vitamins, minerals, medicines)</td>
<td>Anything else</td>
</tr>
<tr>
<td>Predominant breast-feeding</td>
<td>Breast milk (including milk expressed or from wet-nurse) as the predominant source of nourishment</td>
<td>Liquids (water, and water-based drinks, fruit juice, ORS), ritual fluids and drops or syrups (vitamins, minerals, medicines)</td>
<td>Anything else (in particular, non-human milk, food-based fluids)</td>
</tr>
<tr>
<td>Complementary feeding</td>
<td>Breast milk and solid or semi-solid foods</td>
<td>Any food or liquid including non-human milk</td>
<td></td>
</tr>
<tr>
<td>Breast-feeding</td>
<td>Breast milk</td>
<td>Any food or liquid including non-human milk</td>
<td></td>
</tr>
<tr>
<td>Bottle-feeding</td>
<td>Any liquid or semi-solid food from a bottle with nipple/teat</td>
<td>Any food or liquid including non-human milk. Also allows breast milk by bottle</td>
<td></td>
</tr>
</tbody>
</table>
Table 13. Estimated minimum energy density (kcal/g) required to attain different levels of daily energy intakes at various feeding frequencies, non-breastfed children.*

<table>
<thead>
<tr>
<th>Level of intake kcal/kg body wt/d</th>
<th>Frequency of feeding (meals/24 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Energy density of diet kcal/g</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>.52**</td>
</tr>
<tr>
<td>80</td>
<td>.59**</td>
</tr>
<tr>
<td>90</td>
<td>.65**</td>
</tr>
<tr>
<td>100</td>
<td>.77</td>
</tr>
<tr>
<td>110</td>
<td>1.02</td>
</tr>
<tr>
<td>112</td>
<td>1.05</td>
</tr>
<tr>
<td>120</td>
<td>1.17</td>
</tr>
<tr>
<td>130</td>
<td>1.33</td>
</tr>
</tbody>
</table>

*Based on studies of fully weaned, recovering malnourished children, using only diet periods of children with initial weight-for-height, Z-score > -1. (Data from Brown et al., 1995)

**All data based on observed intakes except for those indicated with double asterisk, which were imputed.

[This table has been updated in accordance with the final version of the state-of-the-art paper]
Table 11. Energy (kcal) consumed from breastmilk and needed from complementary foods by children in industrialized countries, by age group

<table>
<thead>
<tr>
<th>Age group (mo)</th>
<th>Energy consumed from breast milk&lt;sup&gt;ab&lt;/sup&gt;</th>
<th>Energy needed from complementary foods&lt;sup&gt;cd&lt;/sup&gt;</th>
<th>Breast milk intake</th>
<th>Breast milk intake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Avg</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>0-2</td>
<td>294</td>
<td>490</td>
<td>686</td>
<td>110</td>
</tr>
<tr>
<td>3-5</td>
<td>362</td>
<td>548</td>
<td>734</td>
<td>188</td>
</tr>
<tr>
<td>6-8</td>
<td>274</td>
<td>486</td>
<td>698</td>
<td>408</td>
</tr>
<tr>
<td>9-11</td>
<td>41</td>
<td>375</td>
<td>709</td>
<td>789</td>
</tr>
<tr>
<td>12-23</td>
<td>0</td>
<td>313</td>
<td>669</td>
<td>1092</td>
</tr>
</tbody>
</table>

a. For age groups 0-2 and 3-5 months, energy consumed from breast milk (average value taken) taken from exclusively breast-fed infants only (Table 8 in the state-of-the-art paper); and for age groups over 6 months from all children regardless of mode of feeding (i.e., pooled for both feeding modes as shown in the ALL STUDIES category in Table 7 of the state-of-the-art paper).

b. The categories Low, Avg and High correspond to energy intake from breast milk being: Low (Mean-2SD), Average (Mean) and High (Mean +2SD).

c. Energy needed from complementary foods calculated by difference, i.e., energy requirement (Table 9, Butte/Torun in the state-of-the-art paper) minus energy consumed from breast milk (listed in this table).

d. The categories Low, Avg and High correspond to energy intake from breast milk as stated in b.

[This table has been updated in accordance with the final version of the state-of-the-art paper]
ANNEX VI

Joint WHO/UNICEF Consultation on Complementary Feeding
28-30 November 1995
Montpellier, France

List of Participants

Dr L. Allen
Department of Nutrition
University of California
Davis, CA 95616-8669
Tel: 1 916-752 5920
Fax: 1 916-752 3406
e-mail: lhallen@ucdavis.edu

Dr A. Ashworth
Centre for Human Nutrition
London School of Hygiene &
Tropical Medicine
Keppel Street
GB-London WC1E 7HT
Tel: 44 171 927 2135
e-mail: a.hill@lshtm.ac.uk

Dr P. Engle
IFPRI
1200 17th St. N.W.
Washington, D.C. 20036
Tel: 1 202 862-5640
e-mail: p.Engle@cgnet.com

Dr R. Florentino
Food & Nutrition Research Institute
DOST Compound, Gen Santos Ave
Bicutan, Tagig, Metro Manila
Philippines
Tel: 63 2 837 2934
Fax: 63 2 837 2934
e-mail: rff@dostmis.dost.gov.ph

Dr C. Garza
Division of Nutritional Sciences
Cornell University
127 Savage Hall, Ithaca, N.Y. 14850-6301
Tel: 1 607-254 5144
Fax: 1 607-255 1033
e-mail: cg30@cornell.edu

Dr K. Besançon
United de Nutrition
Université Montpellier 2
F-34095 Montpellier
Tel: 33 67 63 36 49
Fax: 33 67 63 36 49

Dr K. Brown
Department of Nutrition
University of California
Davis, CA 95616-8669
Tel: 1 916-752 1992
Fax: 1 916-752 3406
e-mail: kkbrown@ucdavis.edu

Dr K. Dewey
Department of Nutrition
University of California
Davis, CA 95616-8669
Tel: 1 916-752 0851
Fax: 1 916-752 3406
e-mail: kgdewey@ucdavis.edu

Dr J.-P. Habicht
Programme for International Nutrition
Savage Hall
Cornell University
Ithaca, N.Y. 14850-6301
Tel: 1 607-255 4419
Fax: 1 607-255 2806
e-mail: jh48@cornell.edu

Dr W. Lorri
Tanzania Food and Nutrition Centre
22 Ocean Road
P.O. Box 977
Dar-es-Salaam, Tanzania
Tel: 255 51 296213
Fax: 255 51 44029
Dr W. Moussa
16 Kasr Al Str.
Cairo, Egypt
Tel: 20 2 364 6413-364 3522
Fax: 20 2 364 7476

Dr E. Piwoz
SARA Project
Academy for Educational Development
1255 23rd Street, N.W.
Washington, D.C. 20037
Tel: 1 202-884 8816
Fax: 1 202-884 8701
e-mail: epiwoz@aed.org

Dr S. Seshadri
M.S. University of Baroda
Faculty of Home Science
Baroda 390 002, India
Tel: 91 265 329 926
Fax: 91 265 330 980

Dr R. Tannous
Dept. of Food Technology & Nutrition
American University of Beirut
Beirut, Lebanon
Tel: 96 11 343 002
Fax: 1 212 444 5800
e-mail: tannous@layla.aub.ac.lb

Dr A. Tomkins
Centre for International Health
Institute for Child Health
University of London
Guilford Street
GB-London WC1N 1EH
Tel: 44 171 242 9789
Fax: 44 171 404 2062
e-mail: atomkins@ich.bpfm.ac.uk

Dr K. Tontisirin
Institute of Nutrition
Mahidol University
Salaya, Nakhon Pathom
73170 Thailand
Tel: 66 2 441 9740
Fax: 66 2 441 9344

Dr S. Trèche
Laboratoire de Nutrition Tropicale
Centre ORSTOM
BP 5045
F-Montpellier 34032

Tel: 33 67 61 7595
Fax: 33 67 54 7800
e-mail: treche@orstom.orstom.fr

Dr C. Victora
Departamento de Medicina Social
Universidade Federal de Pelotas
CP 464, 96030 Pelotas, RS
Brazil
Tel: 55 532 712442
Fax: 55 532 712645
e-mail: epiceszar@vortex

Dr Mehari Gebre-Medhin (unable to attend)
Department of Pediatrics
University Hospital
Uppsala, Sweden

Secretariat

WHO
Programme of Nutrition

B. Underwood
R. Saadeh, Coordinator
M. de Onis
D. Benbouzid

G. Pelto, CDR

REGIONAL OFFICES

B. de Benoist, Regional Office for Africa
M. Peña, Regional Office for the Americas
A. Verster, Regional Office for the Eastern Mediterranean

UNICEF

Dr L. Lhotska
Dr D. Alnwick
Dr H. Armstrong

ORSTOM

F. Delpuech
M.-C. Dop
K. Simondon

OBSERVERS

J. Willumsen, UNICEF/UK
G. Rocquelin, ORSTOM