

Optimal feeding of low-birth-weight infants

TECHNICAL REVIEW

For further information please contact:

Department of Child and Adolescent Health and Development (CAH)
World Health Organization
20 Avenue Appia, 1211 Geneva 27, Switzerland
Tel +41 22 791-3281 Fax + 41 22 791-4853 Email cah@who.int
Web site <http://www.who.int/child-adolescent-health>

ISBN 92 4 159509 4



Optimal feeding of low-birth-weight infants

TECHNICAL REVIEW

Karen Edmond, MBBS, MSc (Epidemiology), PhD

*London School of Hygiene and Tropical Medicine,
London, U.K.*

Rajiv Bahl, MD, PhD

*Department of Child and Adolescent Health
and Development, WHO, Geneva*



**World Health
Organization**

WHO Library Cataloguing-in-Publication Data

Edmond, Karen.

Optimal feeding of low-birth-weight infants : technical review / Karen Edmond,
Rajiv Bahl.

1. Infant nutrition. 2. Infant, Low birth weight. 3. Nutritional requirements.
4. Feeding methods. 5. Infant food. I. Bahl, Rajiv. II. World Health Organization.
III. Title.

ISBN 92 4 159509 4 (NLM classification: WS 120)

ISBN 978 92 4 159509 4

© World Health Organization 2006

All rights reserved. Publications of the World Health Organization can be obtained from WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel.: +41 22 791 3264; fax: +41 22 791 4857; e-mail: bookorders@who.int). Requests for permission to reproduce or translate WHO publications – whether for sale or for noncommercial distribution – should be addressed to WHO Press, at the above address (fax: +41 22 791 4806; e-mail: permissions@who.int).

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use.

The named authors alone are responsible for the views expressed in this publication.

Designed by minimum graphics
Printed in India

Contents

Acknowledgments	vii
Abbreviations	viii
Executive summary	1
Introduction	7
Methods	9
Results	12
1. Background	12
1.1 Physiological principles of feeding LBW infants	12
1.2 Nutritional requirements	14
1.3 Nutritional sources for LBW infants	14
1.4 Development of feeding ability	23
2. Nutrition	25
2.1 Human milk	25
2.2 Human milk supplementation	39
2.3 Breastmilk substitutes	56
3. Feeding methods	62
3.1 Oral feeding	62
3.2 Intragastric feeding	64
4. Feeding schedules	69
4.1 Initiation of enteral feeding	69
4.2 Progression and scheduling of enteral feeding	74
5. Support	79
5.1 Supportive care for the LBW infant	79
5.2 Support for the breastfeeding mother	90
6. Monitoring	94
6.1 Blood glucose monitoring	94
6.2 Growth monitoring	95
7. Feeding infants of HIV-positive mothers	99
Annex 1. Definitions	101
Annex 2. Levels of evidence	103
Annex 3. Sources and quality of evidence	104
Annex 4. References	107

List of boxes

1.2.1	Recommended daily nutrient allowances for pre-term infants >1000 grams at birth	15
1.3.1	Concentration of nutrients in transitional and mature pre-term human milk compared with mature term milk	16
1.3.2	Nutrient composition of multivitamin supplement formulations	19
1.3.3	Nutrient composition of multicomponent commercial human milk fortifiers	19
1.3.4	Nutrient composition of standard and pre-term infant formulas	21
1.3.5	Nutrient composition of nutrient-enriched “post-discharge” formulas	22
6.2.1	Reference data for size at birth	96
6.2.2	Reference data for postnatal growth of LBW infants with optimal nutritional management	98

List of figures

1.1.1	Average composition of weight gain of a reference fetus during four successive 4-week intervals	12
1.1.2	Age-related changes of total body water and its compartments (intra- and extracellular) from fetal life until adolescence	12
1.1.3	Energy intake and nitrogen retention according to protein intake in pre-term infants	14
6.2.1	Average body weight versus post-menstrual age in weeks	95
6.2.2	Comparison of growth references for pre-term infants	98

List of summary tables of key studies

2.1.1	Effects of mother’s own milk compared with formula feeding on infection or necrotising enterocolitis in low birth weight (LBW) infants	28
2.1.2	Effects of mother’s own milk compared with formula feeding on neurodevelopment in LBW infants	29
2.1.3	Effects of donor human milk compared with formula feeding on infection or necrotising enterocolitis in LBW infants	32
2.1.4	Effects of donor human milk compared with formula feeding on neurodevelopment in LBW infants	33
2.1.5	Effects of donor human milk compared with formula feeding on feed tolerance in LBW infants	33
2.1.6	Effects of exclusive breastfeeding (EBF) duration on neurodevelopment in LBW infants	36
2.1.7	Effects of EBF duration on growth outcomes in LBW infants	37
2.1.8	Effects of EBF duration on iron-deficiency anaemia in LBW infants	38
2.2.1	Effects of Vitamin A supplementation on mortality in LBW infants	40
2.2.2	Effects of iron supplementation of breastfed LBW infants on iron status in the first 6 months of life	44
2.2.3	Effects of zinc supplementation of breastfed LBW infants on mortality	46
2.2.4	Effects of zinc supplementation of breastfed LBW infants on serious morbidity	46

2.2.5	Effects of zinc supplementation of breastfed LBW infants on neurodevelopment	48
2.2.6	Effects of zinc supplementation of breastfed LBW infants on growth outcomes in LBW infants	48
2.2.7	Effects of multi-component fortification of human milk on mortality in LBW infants	52
2.2.8	Effects of multi-component fortification of human milk on necrotising enterocolitis in LBW infants	53
2.2.9	Effects of multi-component fortification of human milk on neurodevelopment in LBW infants	54
2.2.10	Effects of multi-component fortification of human milk on growth outcomes in LBW infants	54
2.3.1	Effects of pre-term formula compared with standard infant formula given from birth until LBW infants attained a weight of 2000 g on neurodevelopment	58
2.3.2	Effects of pre-term formula compared with standard infant formula on growth outcomes in LBW infants	58
2.3.3	Effects of nutrient-enriched post-discharge formula compared with standard infant formula on neurodevelopment in LBW infants	60
2.3.4	Effects of nutrient-enriched post-discharge formula compared with standard infant formula on growth in LBW infants	61
3.1.1	Effects of cup feeding compared with bottle feeding on breastfeeding patterns in LBW infants	63
3.2.1	Effects of nasogastric compared with orogastric tube feeding on feeding patterns in LBW infants	65
3.2.2	Effects of nasogastric compared with orogastric tube feeding on physiological parameters in LBW infants	66
3.2.3	Effects of continuous feeding compared with bolus feeding on necrotising enterocolitis in LBW infants	68
3.2.4	Effects of continuous feeding compared with bolus feeding on growth in LBW infants	68
3.2.5	Effects of continuous compared with bolus feeding on respiratory complications in LBW infants	69
4.1.1	Effects of initiation of maintenance enteral feeds in the first 24 hours of life on mortality rates in LBW infants	72
4.1.2	Effects of initiation of maintenance enteral feeds in the first 24 hours of life on growth outcomes in LBW infants	73
4.1.3	Effects of initiation of maintenance enteral feeds in the first 24 hours of life on biochemical measures in LBW infants	73
4.2.1	Effects of rapid compared with slow feeding progression on necrotising enterocolitis in LBW infants	76
4.2.2	Effects of rapid compared with slow feeding progression on growth outcomes in LBW infants	76
4.2.3	Effects of rapid compared with slow feeding progression on time to reach full enteral feeds in LBW infants	77
5.1.1	Effects of kangaroo mother care compared with conventional care on mortality in LBW infants	82

5.1.2	Effects of kangaroo mother care compared with conventional care on severe morbidity in LBW infants	83
5.1.3	Effects of kangaroo mother care compared with conventional care on neurodevelopment in LBW infants	83
5.1.4	Effects of kangaroo mother care compared with conventional care on breastfeeding patterns in LBW infants	84
5.1.5	Effects of non-nutritive sucking compared with conventional care on growth outcomes in LBW infants	85
5.1.6	Effects of non-nutritive sucking compared with conventional care on hospitalization rates in LBW infants	85
5.1.7	Effects of early compared with conventional discharge of LBW infants on re-hospitalization rates after discharge	88
5.1.8	Effects of early compared with conventional discharge of LBW infants on growth outcomes after discharge	89
5.2.1	Effects of breastfeeding counselling on growth outcomes in LBW infants	91
5.2.2	Effects of breastfeeding counselling on breastfeeding patterns in LBW infants	92

Acknowledgements

Many individuals made significant contributions to this document: Saadet Arsan, Zulfiqar Bhutta, Jane Hawdon, Michael Kramer, Sandra Lang, Joy Lawn, Indira Narayanan, Vinod Paul, Felicity Savage, Richard Schanler, Nalini Singhal, and Anthony Williams.

Special thanks are also due to Reginald Tsang and Tim Mullican for allowing pre-publication access to: Tsang RC, Uauy R, Koletzko B, Zlotkin SH. *Nutrition of the preterm infant: scientific basis and practical guidelines*, 2nd ed. Cincinnati, OH, Digital Educational Publishing, 2005; and the Cochrane Neonatal Collaborative Review Group for providing lists of relevant systematic reviews and randomized controlled trials.

This document was prepared by the World Health Organization's Department of Child and Adolescent Health and Development.

预览已结束，完整报告链接和二维码

<https://www.yunbaogao.cn/report/index/report?re>