



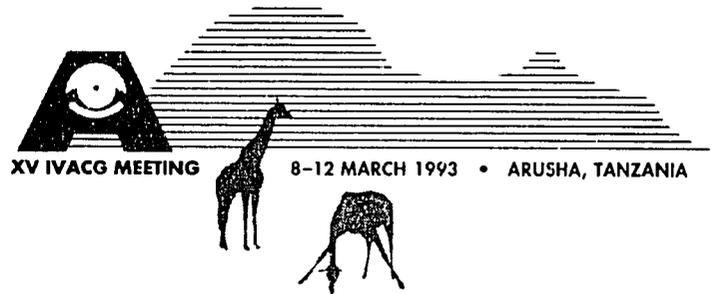
Toward Comprehensive Programs to Reduce Vitamin A Deficiency

A Report of the

XV International Vitamin A

Consultative Group

Meeting



Toward Comprehensive Programs to Reduce Vitamin A Deficiency

XV International Vitamin A
Consultative Group Meeting

Arusha, Tanzania
8-12 March 1993

IVACG Mission

The mission of the International Vitamin A Consultative Group (IVACG) is to guide international activities aimed at reducing vitamin A deficiency in the world. The group offers consultation and guidance to various operating and donor agencies that are seeking to reduce vitamin A deficiency and its accompanying blindness. As part of this service, IVACG has prepared guidelines and recommendations for

- ▲ assessing the regional distribution and magnitude of vitamin A deficiency;
- ▲ developing intervention strategies and methodologies to control vitamin A deficiency;
- ▲ evaluating the effectiveness of implemented programs on a continuing basis; and
- ▲ undertaking research needed to support the assessment, intervention, and evaluation of programs.

Monographs published by the International Vitamin A Consultative Group are

- ▲ *Guidelines for the Eradication of Vitamin A Deficiency and Xerophthalmia* (1977) (available in English and French)
- ▲ *Recent Advances in the Metabolism and Function of Vitamin A and Their Relationship to Applied Nutrition* (1979)
- ▲ *The Safe Use of Vitamin A* (1980) (available in English and French)
- ▲ *The Symptoms and Signs of Vitamin A Deficiency and Their Relationship to Applied Nutrition* (1981) (available in Spanish only)
- ▲ *Biochemical Methodology for the Assessment of Vitamin A Status* (1982)
- ▲ *Reprints of Selected Methods for the Analysis of Vitamin A and Carotenoids in Nutrition Surveys* (1982)
- ▲ *Periodic, Large Oral Doses of Vitamin A for the Prevention of Vitamin A Deficiency and Xerophthalmia: A Summary of Experiences* (1984)
- ▲ *A Decade of Achievement: The International Vitamin A Consultative Group (IVACG) 1975-1985* (1987)

- ▲ *The Safe Use of Vitamin A by Women During the Reproductive Years* (1986) (available in English, French, and Spanish)
- ▲ *Biochemical Methodology for the Assessment of Carotenenes* (1987)
- ▲ *Guidelines for the Use of Vitamin A in Emergency and Relief Operations* (1988)
- ▲ *Vitamin A Supplements: A Guide to Their Use in the Treatment and Prevention of Vitamin A Deficiency and Xerophthalmia* (published by the World Health Organization in conjunction with IVACG and UNICEF, 1988) (available in English and French)
- ▲ *Guidelines for the Development of a Simplified Dietary Assessment to Identify Groups at Risk for Inadequate Intake of Vitamin A* (1989)
- ▲ *Methodologies for Monitoring and Evaluating Vitamin A Deficiency Intervention Programs* (1989)
- ▲ *Nutrition Communications in Vitamin A Programs: A Resource Book* (1992)
- ▲ *A Brief Guide to Current Methods of Assessing Vitamin A Status* (1993)

These reports are available free of charge to developing countries and for \$3.50 (U.S.) to developed countries. Copies can be ordered from the IVACG Secretariat:

IVACG Secretariat
The Nutrition Foundation, Inc.
1126 Sixteenth Street, N.W.
Washington, D.C. 20036
USA

The publication of this report is made possible by support from the Office of Nutrition, Bureau for Research and Development, U.S. Agency for International Development, under Cooperative Agreement No. DAN-5115-A-00-7114-00 with The Nutrition Foundation, Inc., Washington, D.C.

August 1993

Printed in the United States of America.

Library of Congress Catalog Number 93-79863

ISBN Number 0-944398-22-7

Meeting Organizers

IVACG Steering Committee

Moses Chirambo, M.D.

Frances R. Davidson, Ph.D., IVACG Secretary

Abraham Horwitz, M.D., M.P.H., IVACG Chair

Vinodini Reddy, M.D., D.C.H., FIAP

Leonor Maria Pacheco Santos, Ph.D.

Franz Simmersbach, Ph.D.

Suttalak Smitasiri, Ph.D. Candidate

Alfred Sommer, M.H.Sc.

Barbara A. Underwood, Ph.D., IVACG Steering Committee Chair

Keith P. West, Jr., Dr.P.H.

XV IVACG Meeting Rapporteurs

Keith P. West, Jr., Dr.P.H., Rapporteur

Paul Arthur, M.D., Co-rapporteur

Claver R. Temalilwa, M.Sc., Rapporteur national symposium

Jean Humphrey, Ph.D., Co-rapporteur national symposium

Local Organizing Committee in Tanzania

Festo P. Kavishe, M.D., M.Sc., Coordinator

Godwin Ndossi, Ph.D., Secretary

Claver R. Temalilwa, M.Sc., Chair

IVACG Secretariat

Suzanne S. Harris, Ph.D.

Laurie Lindsay Aomari, R.D.

Acknowledgments

Many organizations and individuals contributed to the success of the XV IVACG Meeting. The IVACG Secretariat acknowledges the essential support and contributions of many groups in Tanzania, especially the Tanzanian government, Food and Agriculture Organization of United Nations, World Bank, UNICEF, United Nations Development Programme, and World Health Organization. The secretariat is indebted to the local organizing committee for the meeting and thanks Mr. Claver R. Temalilwa, chair; Dr. Godwin Ndossi, secretary; and Dr. Festo P. Kavishe, coordinator, for their leadership for the national symposium and local arrangements. These organizations and individuals were gracious and skillful hosts.

Following the meeting, the National Horticultural Research and Training Institute (HORTI Tengeru), the World Vision International Area Development Programs in Sanya and Longido, and the UNICEF-sponsored Child Survival and Development Programme in Hai District hosted study tours for meeting participants. These trips provided an opportunity for participants to learn more about conditions related to vitamin A deficiency in Tanzania, and to view child survival, agriculture, horticulture, sanitation, community action, and education efforts aimed at improving these conditions. Each group met with community members and project organizers in conjunction with observing project activities. Their warm hospitality added to the learning experience.

IVACG Steering Committee members Dr. Moses Chirambo, Dr. Frances R. Davidson, Dr. Abraham Horwitz, Dr. Vinodini Reddy, Dr. Leonor Maria Pacheco Santos, Dr. Franz Simmersbach, Dr. Alfred Semmer, and Dr. Barbara A. Underwood devoted many hours to developing the meeting program. Their careful consideration of the scientific aspects of the program, their concern for developing-country needs, and their useful suggestions

substantially strengthened the meeting. The secretariat thanks the many chairpersons for their guidance and flexibility during program sessions. We are also grateful to the interpreters for the XV IVACG Meeting, who navigated the accents of many nations to carefully translate sessions into French.

Dr. Keith P. West, Jr., Dr. Paul Arthur, Mr. Claver R. Temalilwa, and Dr. Jean Humphrey, rapporteurs for this meeting, had the monumental task of unifying diverse presentations into a lasting record of the presentations and discussions. Through their efforts the deliberations will reach readers worldwide concerned with vitamin A deficiency.

The Deputy Minister of Health, Mrs. Zakia Meghji, and the local organizing committee warmly welcomed us to Arusha during an opening-night reception. Refreshments during the meeting were generously provided by Bonite Bottlers Limited and Tanzania Tea Blenders. These contributions added to the camaraderie of the week's events. We also thank the Arusha International Conference Centre for their flexibility and excellent service.

The Office of Nutrition, Bureau for Research and Development, U.S. Agency for International Development; Task Force SIGHT AND LIFE of F. Hoffmann La Roche Ltd.; the International Development Research Centre, acting on behalf of donors to the Micronutrients Initiative; the Australian International Development Assistance Bureau; Nestlé S.A.; The Procter & Gamble Company; and Mrs. Martin Solow were generous in their support of international participants.

The IVACG Secretariat deeply appreciates the many ideas, kind cooperation, and full participation of colleagues around the world. The secretariat hopes that the enthusiasm of the XV IVACG Meeting will encourage and inspire them to apply new knowledge to the development of sustainable programs for the global eradication of vitamin A deficiency.

Table of Contents

ABBREVIATIONS	1	Infants	37
INTRODUCTION	3	Lactating Mothers	37
PROGRAM	5	Other High-Risk Groups of Children	37
INAUGURATION	27	DIETARY DIVERSIFICATION STRATEGIES	37
VITAMIN A NATIONAL SYMPOSIUM: THE NATIONAL VITAMIN A DEFICIENCY CONTROL PROGRAM IN TANZANIA	28	Food-based Strategies to Increase Vitamin A Food Availability and Consumption	37
Introduction	28	Communications and Social Marketing Strategies to Diversify the Diet	38
Interventions	29	METHODOLOGIC ISSUES IN ASSESSING VITAMIN A STATUS	39
Program Supportive Components	29	Indicators of Vitamin A Status: An Overview	39
Proposed Research Activities	30	Clinical and Histological Methods of Assessment	40
VITAMIN A PROJECTS TO PROGRAMS: WHAT DOES IT TAKE?	31	Biochemical Methods of Assessment	40
An International Perspective	31	Other Proxy Methods of Assessment	41
The Transition Period	31	METHODOLOGIC ISSUES IN ASSESSING DIETARY VITAMIN A INTAKE	41
A National Example: Tanzania	32	VITAMIN A STATUS AND DIETARY INTAKE SURVEYS: UPDATE	42
Case Studies: India, Brazil, and the Philippines	32	Vitamin A Status Surveys	43
VITAMIN A PROGRAMS: HOW DO WE KNOW THEY ARE WORKING?	33	Dietary Vitamin A Intake Surveys	44
OPERATIONAL ISSUES	34	VITAMIN A AND CHILD MORTALITY	44
Vitamin A Supplementation	34	Recent Community Trials	44
Synergism Between the Community and Health Providers	34	Meta-analysis of Major Vitamin A Trials	45
Vitamin A and the WHO Expanded Programme on Immunization (EPI)	35	VITAMIN A AND CHILDHOOD MORBIDITY	46
Vitamin A and Growth Monitoring	35	Vitamin A and Severe Infection	46
Vitamin A Within Primary Health Care Systems	36	Vitamin A and Mild Infection	47
Protective Efficacy: 200,000 IU versus 100,000 IU	36	LINKING VITAMIN A TO OTHER MICRONUTRIENT ISSUES	48
Supplementing Groups at Special Risk with Vitamin A	36	Iron Deficiency	48
Children with Severe Measles	36	Iodine Deficiency Disorders (IDD)	48
		NEW HORIZONS IN VITAMIN A RESEARCH	49

AGENCY COMMITMENTS FOR THE VIRTUAL ELIMINATION OF VITAMIN A DEFICIENCY BY THE YEAR 2000	50	International Eye Foundation (IEF)	52
Food and Agriculture Organization (FAO) of the United Nations	50	Sight Savers	52
UNICEF	50	Eye Care—PROVAX	53
World Health Organization (WHO)	50	Helen Keller International (HKI)	53
World Bank	51	Wellstart International	53
Administrative Committee on Coordination—Subcommittee on Nutrition (ACC/SCN) of the UN	51	Task Force SIGHT AND LIFE	53
U.S. Agency for International Development (USAID)	51	Asian Vegetable Research and Development Center (AVRDC)	54
Swedish International Development Authority (SIDA)	51	The Nutrition Foundation, Inc.	54
NONGOVERNMENTAL ORGANIZATION COMMITMENTS FOR THE VIRTUAL ELIMINATION OF VITAMIN A DEFICIENCY BY THE YEAR 2000	52	CLOSING REMARKS	55
		REFERENCES	57
		ABSTRACTS	65
		PARTICIPANTS	141
		Local	143
		International	149

Abbreviations Used in This Report

ALRI	acute lower respiratory infection	IU	international units
ARI	acute respiratory infection	IVACG	International Vitamin A Consultative Group
AVRDC	Asian Vegetable Research and Development Center	HIV-1	Human Immunodeficiency Virus Type 1
CI	confidence interval (also means "consumption index")	KAP	knowledge, attitudes, and practices
CIC	conjunctival impression cytology	MRDR	modified relative dose-response
DGLV	dark green leafy vegetables	NGO	nongovernmental organization
DPT	diphtheria-pertussis-tetanus vaccination	OR	odds ratio
DR/R	didehydroretinol/retinol	ORT	oral rehydration therapy
EDP	Essential Drugs Program	PAMM	Program Against Micronutrient Malnutrition
EPI	WHO Expanded Programme on Immunization	PEM	protein-energy malnutrition
FAO	Food and Agriculture Organization of the United Nations	PVO	private voluntary organization
HKI	Helen Keller International	RA	retinoic acid
HPLC	high-performance liquid chromatography	RBP	retinol-binding protein
ICCIDD	International Council for the Control of Iodine Deficiency Disorders	RCT	randomized clinical trial
ICDS	Integrated Child Development Services	RDR	relative dose-response
ICN	International Conference on Nutrition	RE	retinol equivalents
ICT	impression cytology with transfer	RR	relative risk
IEC	information, education, and communication	TFNC	Tanzania Food and Nutrition Centre
IECT	information, education, and communication training	UNDP	United Nations Development Programme
INACG	International Nutritional Anemia Consultative Group	UNICEF	United Nations Children's Fund
		VAC	vitamin A capsule
		VAST	Ghana Vitamin A Supplementation Trials
		WHO	World Health Organization
		XN	night blindness
		X1B	Bitot's spot

Introduction

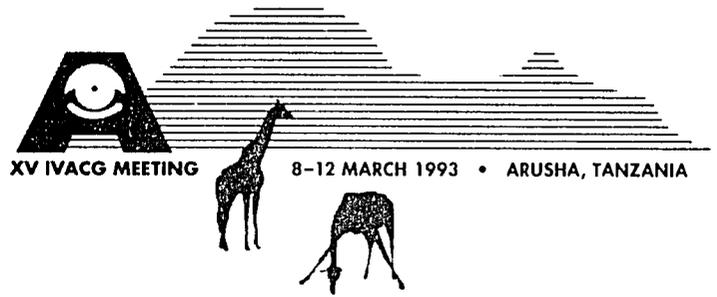
The International Vitamin A Consultative Group (IVACG) is an organization dedicated to reducing the prevalence of vitamin A deficiency worldwide. Established in 1975 with support from the U.S. Agency for International Development, IVACG continues to analyze issues related to the etiology, treatment, and prevention of vitamin A deficiency. IVACG activities involve scientists, programmers, and policy makers throughout the world who are working to prevent this nutritional deficiency. Through its international meetings, IVACG provides a forum for new ideas, encourages innovations, recognizes important research findings, increases awareness of the latest survey data, and promotes action programs.

Representatives from 51 countries were among the 294 policy makers, implementors, and scientists in health, nutrition, biochemistry, agriculture, horticulture, and development who participated in the XV IVACG Meeting, held 8-12 March 1993 in Arusha, Tanzania. Throughout the five-day program, 132 oral, poster, and video presentations addressed the theme "Toward Comprehensive Programs to Reduce Vitamin A Deficiency." Presenters also focused on research concerning progress in changing dietary behaviors related to vitamin A, newer methodologies for assessing subclin-

ical vitamin A deficiency, consequences for human health and development of vitamin A deficiency, and functions of vitamin A. Colleagues had opportunities to share perspectives at 17 exhibits and during study tours, discussion periods, and social events. This report attempts to convey much of the material presented and some of the discussion that followed.

Recent landmark developments have inspired political commitment to the virtual elimination of vitamin A deficiency as a public health problem within the decade. IVACG strongly supports this goal. Although the difficulties of reaching it are enormous, the progress to date is impressive. Emphasis on moving from small projects to larger, more comprehensive programs and making use of the knowledge of successes and obstacles experienced by colleagues in many countries will build on this progress.

At the meeting, IVACG chair Dr. Abraham Horwitz emphasized: "The persistence of vitamin A deficiency anywhere in the world is cruel, because it exposes mothers and children to great risks; it is immoral, because it ignores basic human values; and it is unacceptable, because it can be prevented."



Program

Views expressed by the presenters do not necessarily reflect the views of IVACG or The Nutrition Foundation, Inc.

Sunday, 7 March 1993

1800-2130 **Early Registration** at Novotel Mt. Meru Hotel

Monday, 8 March 1993

0800 **Registration continues** at Arusha International Conference Centre
Set up for poster session: Activities for the Control of Vitamin A
Deficiency in Tanzania

0900-1730 Activities for the Control of Vitamin A Deficiency in Tanzania posters
on display, presenters available 1515-1600

0900 **Inauguration**

Master of Ceremonies: Dr. Festo Kavishe, Managing Director,
Tanzania Food and Nutrition Centre

Mr. E.G. Moyo, Chair, National Vitamin A Consultative Group

Dr. E.A. Duale, WHO Representative, Tanzania

Mr. Dan Toole, UNICEF Delegate, Tanzania

Dr. Frances R. Davidson, Deputy Director, Office of Nutrition,
Bureau for Research and Development, US Agency for International
Development

Dr. Franz Sinnersbach, Headquarters Representative, FAO

Dr. E.A. Duale, on behalf of Dr. Gottlieb L. Monekosso, Regional
Director, African Regional Office, World Health Organization

Mr. Cole Dodge, UNICEF Representative, Regional Office

Dr. Abraham Horwitz, Chair, International Vitamin A Consultative
Group

Mrs. Zakia Meghji, Deputy Minister of Health, Tanzania

1030 **Break**

Program

Monday 8 March 1993 (continued)

1050	National Symposium Session Chair: Dr. B.B.O. Mmbaga
1050	An Overview of the National Programme for Prevention and Control of Vitamin A Deficiency and Xerophthalmia in Tanzania Mr. C.R. Temalilwa
1115	Vitamin A Capsule Distribution Through the Primary Health Care System: The Tanzania Experience Mr. M. Kweba
1140	Monitoring Impact Through the Sentinel Xerophthalmia Surveillance System Dr. Godwin Ndossi
1205	Discussion and announcements
1230	Lunch
1400	National Symposium Session Chair: Dr. Godwin Ndossi
1400	Dietary Approaches for the Control of Vitamin A Deficiency in Tanzania Mr. L. Mselle
1425	Information, Education, Communication and Training in the Vitamin A Deficiency Programme in Tanzania Mrs. Hidaya Missano
1450	Initiation of Control of Vitamin A Deficiency Through Primary Health Care Dr. B.B.O. Mmbaga
1515	Break and Poster Session on Activities for the Control of Vitamin A Deficiency in Tanzania with presenters available
1600	National Symposium Session Chair: Ms. Joyce Hamisi
1600	Public Health Measures in the Control of Vitamin A Deficiency: A Proposal to Control Intestinal Parasites Prof. C. Kihamia
1625	A Proposed Plan for Tea Fortification with Vitamin A Mr. C.R. Temalilwa
1650	Discussion and announcements
1730	End of day's formal sessions
1900	Reception at Novotel Mt. Meru Hotel Deputy Minister of Health and the Local Organizing Committee

Tuesday, 9 March 1993

0800 Set up for poster sessions: Program Issues and New Human
 Research on the Functions of Vitamin A

0900-1800 Program Issues and New Human Research on the Functions of
 Vitamin A poster sessions on display, presenters available 1515-1600

0900 Projects to Programs: What does it take?

Chair: Dr. Abraham Horwitz

0910 International Perspective
 Mr. James Greene

0940 National Perspective
 Dr. Festo Kavishe

1000 National Perspectives Panel
 1000 India: Dr. Vinodini Reddy
 1010 Brazil: Dr. Leonor Santos
 1020 Philippines: Dr. Florentino Solon

1030 Break

1100 Programs: How do we know they are working?

Chair: Dr. Aree Valyasevi

1100 International Perspective
 Dr. John B. Mason

1130 National Perspective
 Dr. Ignatius Tarwotjo

1200 Discussion and announcements

1230 Lunch

1400 Operational Issues Defined by Field Experience

Chair: Dr. Franz Simmersbach

1400 Cost, Coverage and Change of Health Status Associated with
 Alternative Approaches to the Control of Vitamin A Deficiency
 in Nepal
 Dr. Robert L. Tilden

1420 Success of Communication Programme in Reducing Vitamin A
 Deficiency Through Changing Dietary Habit: Worldview—Nutritional
 Blindness Prevention Programme
 Dr. Nazrul Islam

1440 Social Marketing in the Prevention and Control of Vitamin A
 Deficiency: An Unfinished Agenda
 Dr. Joseph Sclafani

1500 Discussion

Program

Tuesday, 9 March 1993 (continued)

1515	Break and Vitamin A Program Issues Poster Session with presenters available
1600	Vitamin A Program Issues Chair: Dr. Moses Chirambo
1600	Evaluation of A Policy of Routine High Dose Vitamin A Therapy for Children Hospitalized with Measles Dr. Greg Hussey
1615	Vitamin A Supplementation in Bolgatanga-Frafra District Ghana: Costs and the Window of Opportunity for Integration with EPI Dr. Dyna C. Arhin
1630	Vitamin A Supplementation in Chikwawa District, Malawi: Mother's Knowledge, Delivery Strategies, Missed Opportunities Mr. John M. Barrows
1645	Vitamin A Status and Lactation in Indonesian Women: A Randomized Trial of High-Dose Supplementation in the Post-Partum Period Dr. Rebecca J. Stoltzfus
1700	Factors Affecting the Utilization of Community Based Micronutrient Interventions in Eastern Indonesia Dr. Peter Fajans
1715	Factors Associated with Coverage of Vitamin A Capsule Distribution in a District in Central Java, Indonesia, 1991 Dr. Hamam Hadi
1730	Summary of Vitamin A Program Issues Poster Session Dr. Benny Kodyat
1745	Discussion and announcements
1815	End of day's formal sessions
1915	IVACG Steering Committee dinner and meeting
1915	Demonstration of PROFILES: Computer graphics for promoting the importance of nutrition in national development (At Novotel Mt. Meru Hotel) Dr. Bart Burkhalter

Wednesday, 10 March 1993

0800-0830	Set up for poster sessions: Consequences for Human Health and Development of Vitamin A Deficiency Newer Methodologies for Assessing Subclinical Vitamin A Deficiency
0830-1800	Wednesday poster sessions on display, presenters available 1400-1445
<hr/>	
0830	Vitamin A and Childhood Mortality: Reports from Clinical Trials Chair: Dr. George Beaton
0830	The Effects of Vitamin A Supplementation on Childhood Mortality in Northern Ghana Dr. David Russ and Ms. Nicola Dollimore
0900	Discussion
0915	Impact of Periodic Vitamin A Supplementation on Early Infant Mortality in Nepal Dr. Keith P. West, Jr.
0930	Discussion
0945	Effectiveness of Vitamin A Supplementation in Control of Young Child Morbidity and Mortality in Developing Countries Prof. George Beaton
<hr/>	
1025	Break
<hr/>	
1050	Vitamin A and Childhood Morbidity: Reports from Clinical Trials Chair: Dr. Alfred Sommer
1050	Vitamin A Supplementation Reduces Severity of Childhood Illnesses in Ghana Dr. Paul Arthur
1110	Effect of Vitamin A Supplementation on Childhood Morbidity in Northeast Brazil Dr. Mauricio L. Barreto
1130	Impact of High Dose Vitamin A Supplementation on Incidence and Duration of Episodes of Diarrhea and Acute Respiratory Infections in Preschool Indonesian Children Dr. Michael J. Dibley
1150	Discussion and announcements
<hr/>	
1230	Lunch
<hr/>	

Program

Wednesday, 10 March 1993 (continued)

- 1400 **Poster sessions** with presenters available:
Consequences for Human Health and Development of Vitamin A Deficiency
Newer Methodologies for Assessing Subclinical Vitamin A Deficiency
- 1445 **Special Presentations on Vitamin A Distribution**
Chair: Dr. Aaron Lechtig
- 1445 Vitamin A Deficiency in Infancy
Dr. Barbara A. Underwood
- 1455 Safety of Vitamin A Supplementation Through EPI in Bangladesh
Dr. Andres de Francisco
- 1505 Delivering Vitamin A Supplements at Immunization Contacts
Dr. Nicholas Cohen
- 1515 Prerequisites for the Initiation of "Universal" VAC Distribution:
A Policy Think Piece
Dr. Ted Greiner
- 1530 Discussion
-
- 1550 Break
-
- 1620 **Newer Methodologies for Assessing Subclinical Vitamin A Deficiency**
Chair: Dr. James A. Olson
- 1620 Indicators of Vitamin A Status: An Overview
Dr. James A. Olson
- 1635 Issues of Using Dietary Methods of Assessment for Vitamin A Deficiency
Dr. S. Ismail
- 1650 Issues Related to Clinical and Histological Methods of Assessment for Vitamin A Deficiency
Dr. Alfred Sommer
- 1705 Issues Related to Biochemical Methods of Assessment for Vitamin A Deficiency
Dr. David Ross
- 1720 **Summary of Consequences for Human Health and Development of Vitamin A Deficiency Poster Session**
Dr. Michael Lathan
- 1735 Discussion and announcements
- 1800 End of day's formal sessions
- 1900 IVACG Steering Committee dinner and meeting with IVACG Regional Representatives for Africa

Thursday, 11 March 1993

0800-0830	Set up for poster sessions: Dietary Behavior and Surveys
0830-1715	Thursday poster sessions on display, presenters available 1530-1615
<hr/>	
0830	Linking Vitamin A to Other Micronutrient Issues, e.g., Iron and Iodine Chair: Dr. Anna Verster
0830	Iron Deficiency: The Global Perspective Dr. James Cook
0850	Overview and Update of Iodine Deficiency Dr. Rainer Gutekunst
0910	Panel discussion on Linking Vitamin A to Other Micronutrient Issues, e.g., Iron and Iodine Dr. James Cook Dr. Rainer Gutekunst Dr. Samuel G. Kahn Dr. Frederick Trowbridge
0950	Effects of an Oral Iodine Preparation on the Stability of Retinyl Palmitate Dr. James A. Olson
1005	Role of Vitamin A in Nutritional Anemia: Recent Studies in Pregnant Women in Indonesia, Children in Ethiopia, and in Laboratory Animals Dr. Clive E. West
1020	Discussion
<hr/>	
1040	Break
<hr/>	
1100	Agency Commitments for the Virtual Eradication of Vitamin A Deficiency by the Year 2000 Chair: Dr. Suzanne Harris
1100	Food and Agricultural Organization of the United Nations Dr. Franz Simmersbach
1115	UNICEF Mr. David Alnwick
1130	World Health Organization Dr. Barbara A. Underwood
1145	World Bank Mr. James Greene
1200	Administrative Committee on Coordination-Subcommittee on Nutrition (ACC/SCN) Dr. Abraham Horwitz

Program

Thursday, 11 March 1993 (continued)

1215	Discussion and announcements
1230	Lunch
1400	Agency Commitments for the Virtual Eradication of Vitamin A Deficiency by the Year 2000 (continued) Chair: Dr. Suzanne Harris
1400	United States Agency for International Development (USAID) Dr. Frances R. Davidson
1415	Swedish International Development Authority (SIDA) Dr. Ted Greiner
1430	United Nations Development Programme, Tanzania Dr. Erick Boateng
1445	Discussion
1530	Break and Poster Sessions Concerning Dietary Behavior and Surveys with presenters available
1615	Summaries of Thursday Poster Sessions Chair: Dr. Pawlos Quana'a
1615	Summary of Dietary Behavior Poster Session Ms. Suttalak Smitasiri
1630	Summary of Survey Poster Session Dr. Rodolfo Florentino
1645	Discussion and announcements
1715	End of day's sessions at AICC
1900-2030	Video presentations at Novotel Mt. Meru Hotel Chair: Ms. Ann Burgess

Friday, 12 March 1993

0830	Nongovernmental Organization Commitments for the Virtual Eradication of Vitamin A Deficiency by the Year 2000 Chair: Dr. Martin Bloem
0830	International Eye Foundation Mr. John Barrows
0840	Sight Savers Mr. Peter Dixon
0850	Eye Care—PROVAX Dr. Alix Fleury
0900	Helen Keller International Dr. Joseph Sclafani
0910	Prevention of Vitamin A Deficiency Through Breastfeeding Promotion: The Role of Wellstart International Prof. Vicky Newman
0920	The Roche SIGHT AND LIFE Task Force: Reflections on Past and Future Activities Dr. John Gmünder
0930	Asian Vegetable Research and Development Center Dr. Romeo Opeña
0940	The Nutrition Foundation, Inc. Ms. Laurie Lindsay Aomari
0950	Discussion
<hr/>	
1030	Break
<hr/>	
1130	Future Perspectives on Vitamin A Chair: Dr. Abraham Horowitz
1130	New Horizons in Vitamin A Research Dr. Frank Chytil
1200	Closing remarks Dr. Abraham Horowitz
1230	End of formal sessions

Program

Saturday, 13 March 1993

Study tours organized by local committee in Tanzania.

- ▲ National Horticultural Research and Training Institute (HORTI Tengeru)
- ▲ World Vision International Area Development Programs in Sanya and Longido
- ▲ UNICEF-sponsored Child Survival and Development Programme in Hai District

Poster and Video Sessions

Monday, 8 March 1993

1515-1600 **Activities for the Control of Vitamin A Deficiency in Tanzania
Poster Session** (set up 0800 Monday)

1. Tengeru Horticultural Activities
 Mr. R.E.A. Swai
2. IEC Materials
 Mrs. Hidaya Missano
3. Red Palm Oil
 Mr. G.T. Ndunguru
4. Diet Modification
 Mr. L. Mselle
5. Knowledge, Attitudes, and Practices Study in Shinyanga
 Mrs. F. Magambo
6. Solar Drying in Tanzania
 Mrs. Generose Mulokozi
7. Solar Drying Vitamin A-Rich Foods
 Ms. Mary Linchan
8. Laboratory Support to the National Programme on Vitamin A
Deficiency
 Mrs. Generose Mulokozi and Mr. Claver Temalilwa

Tuesday, 9 March 1993

1515-1600 **Vitamin A Program Issues Poster Session** (set up 0800 Tuesday)

1. Characteristics of Non-Responsive Bitot's Spots in Nepal
 Dr. Filippo Curtale
2. FAO/Australia-Nutrition Improvement Project, Vietnam:
A Multisectoral, Community- Based Approach to Addressing Food
and Nutrition Problems
 Dr. Tu Ngu
3. Relative Protection of One Oral 100,000 IU or 200,000 IU Dose
Vitamin A Against Deficiency
 Dr. Jean Humphrey
4. Vitamin A Supplementation: A Must During Supplementary Feeding
in Refugee Camps in Zimbabwe
 Prof. N.Z. Nyazema

Program

Tuesday, 9 March 1993 (continued)

5. Integration of the Delivery of Vitamin A Supplements to Infants and Post-Partum Women into the Routine Immunization Program on Lombok Island, Republic of Indonesia
Dr. Augustinus Sutanto
6. Integration of Vitamin A Capsule Supplementation Into Operation Timbang: A Team Approach
Ms. Charito S. Tuason
7. Evaluation of the National Xerophthalmia Control Program Indonesia 1992
Dr. Muhilal

1515-1600

New Human Research on the Functions of Vitamin A Poster Session (set up 0800 Tuesday)

8. Increased Mortality Associated with Vitamin A Deficiency during HIV Infection
Dr. Richard D. Semba
9. Molecular Mechanisms of Action for Vitamin A-Derived Hormones
Dr. Magnus Pfahl

Wednesday, 10 March 1993

1400-1445

Consequences for Human Health and Development of Vitamin A Deficiency Poster Session (set up 0800 Wednesday)

1. The Impact of Vitamin A Supplementation in Preschool Children in Iringa, Tanzania
Dr. Godwin D. Ndossi
2. Effect of Vitamin A Supplementation on Growth and Morbidity of Preschool Children in a Growth Monitoring Research Project in Southern India
Mrs. Usha Ramakrishnan
3. The Relationship Between Vitamin A Status and Severity of Acute Respiratory Tract Infections in Children
Dr. Greg Hussey
4. Effect of a Single Oral Dose of Vitamin A (200,000 IU) on Morbidity in Acute Measles Cases Recruited at Urban Clinics in Ndola, Zambia
Dr. Chris Kjolhede
5. Determinants of Vitamin A Deficiency in Northern Ghana
Dr. Saul Morris

Wednesday, 10 March 1993 (continued)

1400-1445

Newer Methodologies for Assessing Subclinical Vitamin A Deficiency Poster Session (set up 0800 Wednesday)

6. Can Community Serum Vitamin A Levels be Used for Predicting the Risk of Xerophthalmia?
Ms. Atmarita
7. Serum Retinol and Acute Phase Proteins of Children in Northern Ghana
Dr. Suzanne Filteau
8. The Stability of Vitamin A Circulating Complex in Spots of Dried Serum Samples Absorbed on Filter Paper
Dr. E.M. Kafwembe
9. Vitamin A Status in Preschool Indonesian Children as Measured by the Modified Relative-Dose Response Assay
Dr. Michael J. Dibley
10. Comparisons of Vitamin A Assessment Techniques in Indonesian Children and Further Refinement of the Modified Relative Dose Response (MRDR)
Ms. Sherry Tanunihardjo
11. Relation Between Impression Cytology Test and Trachoma
Dr. Serge Resnikoff
12. Assessment of Vitamin A Status in China by the Modified Conjunctival Impression Cytology (CIC) Method
Dr. Han Ya-shan
13. A Comparison of Serum Retinol Levels and Conjunctival Impression Cytology Results in Young Children in Ghana
Dr. David A. Ross
14. Assessment of Vitamin A Status by a Prototype Dark Adaptometer
Dr. Nathan Congdon
15. Risk Factors for Xerophthalmia in Nepal
Dr. S.K. Khattry
16. Villages in Transition: Elevated Risk of Micronutrient Deficiency
Dr. William D. Drake
17. Experiences in Training and Use of Modified Versions of the IVACG Simplified Dietary Guidelines
Dr. Mohamed Mansour

Program

Wednesday, 10 March 1993 (continued)

18. A Simple Method to Assess Vitamin A Intake: Experience with a Food Frequency Questionnaire for Preschool Children in Rural Central Java, Indonesia
Mrs. Th. Ninuk S.H.
19. Validation of the HKI Food Frequency Method to Identify Communities with Vitamin A Deficiency
Dr. Nancy L. Sloan
20. Assessment of the Dietary Intake of Vitamin A by Preschool Indonesian Children by Two Methods
Dr. Jean Humphrey
21. A Simplified Food Frequency Method to Assess Relative Vitamin A Intake
Dr. Rebecca J. Stoltzfus

Thursday, 11 March 1993

1530-1615

Dietary Behavior Poster Session (set up 0800 Thursday)

1. Production, Vitamin A Content, and Consumer Acceptability of a "Instantized" Sweet Potato Product Prepared in the Form of a Gruel Beverage or Puree Paste: Experience in Guatemala
Dr. Jesus Bulux
2. Dietary Habits and β -Carotene Rich Food Intakes of Children (6-12 Years of Age) Participating in the Dr. M.G.R. Nutritious Meal Programme
Dr. Rajammal P. Devadas
3. Assessment of Dietary Behavior Related to Vitamin A in Uganda
Mrs. Louise Sserunjogi
4. The Impact of Vegetable Variety on Children's Vegetable Consumption in Bangladesh
Dr. A.K. Tabibul

1530-1615

Survey Poster Session (set up 0800 Thursday)

5. Vitamin A Deficiency in the South Pacific: Tuvalu, Vanuatu, Solomon and Cook Islands
Ms. Mary Linehan
6. The Assessment of Vitamin A Deficiency in Three Cities in Mozambique
Dr. Manuel L. Romano Julien
7. Kamuli Blindness and Vitamin A Deficiency Survey
Dr. Medi Kawuma

Thursday, 11 March 1993 (continued)

8. Vitamin A Deficiency in the Dominican Republic
Dr. Hugo R. Mendoza
9. The Vitamin A Intake of Lactating and Non-lactating Non-pregnant Women in Rural West Java and Local Food Restrictions Which Limit Their Vitamin A Intake
Dr. Saskia de Pee
10. Bolivia Vitamin A Deficiency Prevalence Assessment
Dr. David Nelson
11. The Prevalence of Vitamin A Deficiency and Iron Deficiency Anemia of Preschool Children in Panama
Dr. David Nelson
12. Prevalence of Xerophthalmia and Risk of Vitamin A Deficiency Among Children in the Extreme North Province of Cameroon
Mr. Emmanuel Atud Atina
13. The Implications of Urbanization for Vitamin A Deficiency Amongst Children in South Africa
Ms. Anna Coutsoudis

1900-2030

Video Presentations at Novotel Mt. Meru Hotel

- | | |
|------|---|
| | Chair: Ms. Ann Burgess |
| 1900 | From Darkness Into Light
Mr. Nazrul Islam |
| 1920 | The Vitamin A Child Survival Project
Dr. Filippo Curtale |
| 1940 | Ending Hidden Hunger
Dr. Aaron Lechtig |
| 2000 | Vitamin A and Child Survival
Ms. Nancy Haselow |

Exhibits

Chair: Dr. Miriam Chavez

Exhibits on display during coffee breaks and poster sessions on Tuesday, Wednesday, Thursday, and Friday.

- ▲ Solar Drying (organized by Tanzania Food and Nutrition Centre and VITAL). This exhibit includes a demonstration of the technique, and shares information from applications in the following countries:
 - Tanzania—Tanzania Food and Nutrition Centre
 - Haiti—Save the Children
 - Dominican Republic—Fundación para el Desarrollo Comunitario, Inc. (FUDECO)
- ▲ The Nutrition Foundation, Inc.
Dr. Suzanne Harris
- ▲ Tanzania Food and Nutrition Centre
Mrs. Sylvia F. Shao
- ▲ Vitamin A Assessment Manual
Ms. Sherry Tanumihardjo and Dr. James Olson
- ▲ Wellstart International
Prof. Vicky Newman
- ▲ FAO Publications and Vitamin A Activities in Africa
Dr. Ndiaye Cheikh and Dr. Franz Simmersbach
- ▲ Helen Keller International
Ms. Nancy Haselow
- ▲ Clearinghouse on Infant Feeding and Maternal Nutrition
Ms. Man-Ming Hung
- ▲ VITAL
Ms. Mary Linehan
- ▲ Task Force SIGHT AND LIFE
Dr. John Gmünder
- ▲ Worldview International Foundation
Mr. Nazrul Islam
- ▲ Program Against Micronutrient Malnutrition (PAMM)
Dr. Frederick L. Trowbridge
- ▲ Food and Nutrition Board, Government of India
Mrs. Shashi Prabha Gupta
- ▲ World Health Organization Micronutrient Deficiency Information System
- ▲ *Xerophthalmia Club Bulletin*
- ▲ International Eye Foundation, Guatemala

Contributors to the XV IVACG Meeting

The XV IVACG Meeting was made possible by support from the Office of Nutrition, Bureau for Research and Development, U.S. Agency for International Development, under Cooperative Agreement No. DAN-5115-A-00-7114-00 with The Nutrition Foundation, Inc., Washington, D.C.

The IVACG Secretariat gratefully acknowledges the additional contributions of the following individuals and organizations:

Australian International Development Assistance Bureau
 Bonite Bottlers, Ltd.
 The Coca-Cola Company
 Government of Tanzania
 Food and Agriculture Organization, Tanzania
 International Development Research Center
 Local Organizing Committee in Tanzania
 Nestlé S.A.
 The Procter and Gamble Company
 Mrs. Martin Solow
 Tanzania Tea Blenders
 Task Force SIGHT AND LIFE
 The World Bank, Tanzania
 UNICEF, Tanzania
 United Nations Development Programme, Tanzania
 World Health Organization, Tanzania

IVACG Steering Committee

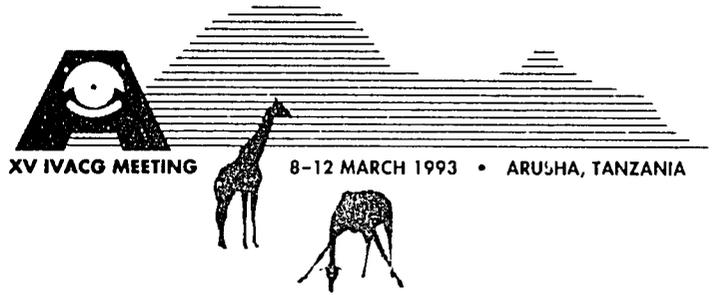
Moses Chirambo, M.D.
 Frances R. Davidson, Ph.D., IVACG Secretary
 Abraham Horwitz, M.D., M.P.H., IVACG Chair
 Vinodini Reddy, M.D., D.C.H., FIAP
 Leonor Maria Pacheco Santos, Ph.D.
 Franz Simmersbach, Ph.D.
 Alfred Sommer, M.D., M.H.Sc.
 Barbara A. Underwood, Ph.D., IVACG Steering Committee Chair

Local Organizing Committee in Tanzania

Festo P. Kavishe, M.D., M.Sc., Coordinator
 Godwin Ndossi, Ph.D., Secretary
 Claver Temalilwa, M.Sc., Chair

IVACG Secretariat Staff

Laurie Lindsay Aomari, R.D.
 Diane Dalisera, M.B.A.
 Carolyn Darrehmane
 Suzanne S. Harris, Ph.D.
 Dwayne Milbrand



Summary

INAUGURATION

The XV IVACG Meeting was inaugurated in the scenic town of Arusha, situated at the foot of Mt. Meru, a 15,000-foot volcano, in northern Tanzania. Dr. Festo Kavishe, managing director of the Tanzania Food and Nutrition Centre, extended a warm welcome to delegates and gratitude to USAID, UNICEF, WHO, UNDP, the local organizing committee (chaired by Mr. C.R. Temalilwa), local businesses, the IVACG Steering Committee, and the government of Tanzania for making possible this largest IVACG meeting to date, dedicated to translating the goals of vitamin A deficiency prevention into reality (1).^{*} Mr. E. Moyo sketched the activities of a country that is committed to meeting this challenge, as reflected by the vision, objectives, diverse membership, and accomplishments of Tanzania's own National Vitamin A Consultative Group (2).

Local, regional, and international representatives of United Nations organizations (3-7), USAID (8), and IVACG (9) expressed their appreciation to the government of Tanzania for hosting the IVACG Meeting. They and the honorable deputy minister of health of Tanzania (10) placed into perspective the comprehensive aspect of vitamin A deficiency prevention. While immediate efforts to define and prevent vitamin A deficiency represent responsible action (4), a comprehensive, preventive approach must also address underlying dietary causes through relevant food based and nutrition education measures (3,4,6). Vitamin A deficiency rarely occurs in isolation. Rather, it tends to result in conjunction with a diet of inadequate variety, quality, and quantity (3,6).

Working to improve and diversify the diet in practical and sustained ways also serves a number of sectoral and national development goals (3,4,6,8).

The fact that the IVACG Meeting was being held in East Africa, with its success stories and future challenges, was alluded to in the opening remarks. Speakers drew attention to the systematic efforts of Tanzania over the past 20 years to achieve a coordinated micronutrient deficiency control strategy through supplementation, dietary improvement, and (in the case of iodine) fortification (3,4,10). Within the context of widespread malnutrition in the Horn of Africa, hope was expressed about the chances to unite "commitment with opportunity" to resolve vitamin A deficiency as we approach the year 2000 (7,10).

Speakers at the meeting inauguration noted the timeliness of this first IVACG meeting that follows the issuance of the World Declaration and Plan of Action from the International Conference on Nutrition (ICN) in Rome in December 1992. Readily apparent are the need and opportunities to link the advances at this IVACG meeting to the micronutrient goals of the ICN, the Montreal Conference on Ending Hidden Hunger, and the World Summit for Children (3,8,9). Dr. Horwitz, the chairperson of IVACG, urged that the global momentum to "virtually eliminate vitamin A deficiency" be seized and that comprehensive and coordinated measures be undertaken to prevent vitamin A deficiency through continuous assessment, analysis, and action (the "triple A" approach) (9).

^{*} Numbers in parentheses refer to presentations at the meeting and published work cited at the meeting (see References on pp. 57-63 herein)

VITAMIN A NATIONAL SYMPOSIUM

The National Vitamin A Deficiency Control Program in Tanzania

INTRODUCTION (11)

Based on anecdotal information from health workers, review of data from schools for the blind, and returns of the sentinel xerophthalmia surveillance system and community-based surveys results, it is clear that vitamin A deficiency and xerophthalmia are important public health problems in Tanzania. The Tanzania Food and Nutrition Centre (TFNC) estimates that 1.36 million Tanzanians or 6.1% of the population are vitamin A deficient, 98% of whom are children under 6 years of age. It is further estimated that there are 10,000 children suffering from xerophthalmia at any one time, with 2000–4000 new cases of blindness every year.

While vitamin A deficiency is more severe in drought-stricken areas of the country (Singida, Shinyanga, Dodoma, Tabora, parts of Arusha, Mara, Kilimanjaro, and Kigoma), it has been also observed in areas where vitamin A-rich foods are plentiful (Iringa, Kagera, Kilimanjaro). Within a given area, remarkable differences in the severity of the problem are found between villages or even between different sections of the same village.

A second 5-year national vitamin A deficiency control program is now in effect. The program is managed and coordinated by a multi-sectoral committee, the National Vitamin A Consultative Group (NVACG). The group is chaired by the assistant commissioner for agriculture responsible for extension services, and TFNC is the secretariat. Members come from the Muhimbili Medical Centre; the Ministries of Health, Agriculture, and Education; the Ministry of Community Development, Women's Affairs and Children; Sokoine Agricultural University; National Prevention of Blindness Committee; and the coordinator of the xerophthalmia surveillance program. UNICEF, WHO, FAO, and IDA are ex officio members. Financial support has come from the Swedish International Development Authority (SIDA), the International Development Research Centre (IDRC) of Canada,

the Canadian International Development Agency (CIDA), the International Programme in the Chemical Sciences (IPICS), the Swedish Agency for Research Cooperation (SAREC), UNICEF, WHO, FAO, and the International Development Association (IDA).

The country has adopted two major interventions for combating vitamin A deficiency: capsule distribution through the Essential Drugs Program (EDP) and promotion of increased consumption of dietary sources and of breastfeeding. There is limited fortification of margarine, infant formula, and commercial weaning foods, but these foods are consumed by relatively affluent families only. These interventions are supported by the sentinel xerophthalmia surveillance system; the information, education, and communication training (IECT) program; the primary health care system; and several research programs.

The biochemical laboratory at the TFNC supports ongoing research and program monitoring and evaluation. Assays in place include retinol and beta-carotene analysis by high-performance liquid chromatography (HPLC) and assessment of subclinical vitamin A deficiency by conjunctival impression cytology (CIC). Laboratory personnel are in the process of setting up the relative dose-response (RDR) and modified RDR techniques.

The national goal is to eliminate vitamin A deficiency and iodine deficiency disorders and to reduce anemia by one-third the 1990 levels by the year 2000. Tangible achievements made to date in meeting these goals are in part due to wide collaboration in research and training with numerous international agencies and universities. In collaboration with the Program Against Micronutrient Malnutrition (PAMM), a 3-year program was recently developed to complement and strengthen ongoing interventions. Introduction of fortification strategies has been proposed to complement capsule distribution and dietary approaches.

Several essential elements for a sustainable community-based control program have been identified over the last 10 years. These include an institutional base with technical and managerial capability, a careful analysis of the un-

derlying causes of vitamin A deficiency, advocacy at all levels, integration of intervention strategies within existing structures, a strong IECT component, periodic evaluation, favorable donor climate, and development of human resources throughout the country.

INTERVENTIONS

VITAMIN A CAPSULE DISTRIBUTION (12)

A disease-targeted capsule distribution program has been in effect since 1987. Included in the kits of the Essential Drugs Program (EDP) are 50,000-IU capsules. The 50,000-IU dose was recommended by the Ministry of Health because of fear of toxicity in cases of misuse. Through the EDP program, capsules reach rural dispensaries and health centers. Secondary and tertiary health facilities are not supplied with EDP kits, but plans are under way to supply them. The capsules are given in accordance with WHO recommendations, modified for Tanzania conditions. Indications for supplementation are active xerophthalmia, measles, marasmus, kwashiorkor or marasmic kwashiorkor, persistent diarrhea, bronchial pneumonia, bronchiolitis, tuberculosis, and whooping cough.

Recently, surveys and monthly inventories revealed large stocks of capsules in rural health facilities. This suggested that health workers were underutilizing vitamin A supplements owing to inadequate knowledge of the diagnosis and management of vitamin A deficiency and xerophthalmia. Training workshops were conducted by TFNC in all districts, and charts describing the diagnosis and management of vitamin A deficiency and xerophthalmia were distributed to all dispensaries and health centers. As a result, capsule utilization has already increased. A study to assess the knowledge, attitude, and practice of health workers toward supplementation and the flow of capsules is under way. To ensure effectiveness of this strategy, communities are now being trained in the identification of children at high risk of developing xerophthalmia for referral to health facilities.

DIETARY APPROACHES FOR THE CONTROL OF VITAMIN A DEFICIENCY IN TANZANIA (13)

Dietary approaches include promotion of

breastfeeding and improved child feeding practices, production and consumption of vitamin A-rich fruits and vegetables, production and consumption of red palm oil, and increased consumption of dietary fat and protein.

A pilot intervention is now being implemented in drought-stricken Singida district. Schools are used as community nurseries and training centers for home gardening and nutrition education of schoolchildren. Planting materials for fruits and vegetables are provided, and solar drying techniques have been introduced to provide carotene sources in the off-season months. Agricultural and community development extension officers train communities in child feeding, and health extension services provide hygiene education. Multisectoral committees are responsible for coordination of the project activities and for involving communities in identifying problems and designing interventions. After 1 year, home gardening has almost doubled, all primary schools have school gardens, and distribution of papaya and guava seedlings is under way. The project is planning to strengthen nutrition education to assure that the increased production will lead to increased dietary intake. In addition, a manual of dietary interventions for arid areas of Tanzania and other African countries will be prepared.

PROGRAM SUPPORTIVE COMPONENTS

SENTINEL XEROPHTHALMIA SURVEILLANCE SYSTEM (14)

The xerophthalmia surveillance system was established in 1982 to document the magnitude of vitamin A deficiency in the country. A specially designed form is used by assistant medical officers at regional hospitals to report all cases of xerophthalmia presenting to eye clinics, dispensaries, and health centers. Completed forms are sent to TFNC, where the data are compiled and analyzed.

The system is used for monitoring trends of xerophthalmia, assessing the impact of interventions, and documenting the geographical distribution, affected age groups, and associated diseases. To encourage better reporting, a newsletter is being planned to provide feedback from the surveillance system to vitamin A deficiency control program implementers.

Summary

INFORMATION, EDUCATION, COMMUNICATION, AND TRAINING (IECT) (15)

The goal of the IECT component is to improve knowledge, attitudes, behavior, and skills of targeted populations in overcoming nutrition problems. IECT also builds the capacity of institutions to provide solutions.

In Tanzania, both governmental and non-governmental organizations provide nutrition training and education. Communication techniques include radio, printed materials, formal and nonformal courses, and training seminars for the lay press. All approaches include vitamin A deficiency.

There are indications that the program may have resulted in improved knowledge, but not in changed behavior. Limitations of the present IECT component include lack of well-established needs assessment procedures, inadequate sectoral collaboration, poor communication infrastructure, inadequate institutional capacity, and lack of a monitoring and evaluation system. Efforts are now under way to strengthen IECT by developing materials and conducting training specifically for the control of vitamin A deficiency.

INITIATION OF CONTROL OF VITAMIN A DEFICIENCY THROUGH PRIMARY HEALTH CARE (16)

The primary health care system has begun a special initiative in Dodoma, a dry region in central Tanzania. Key elements of this intervention include promotion of breastfeeding and proper weaning practices; promotion of production, preservation and consumption of foods rich in vitamin A and fat; prevention of intestinal worm infestation; increased immunization coverage (especially against measles and whooping cough); and increased recognition of clinical eye signs of vitamin A deficiency.

PROPOSED RESEARCH ACTIVITIES

Under the national vitamin A deficiency control program, research activities are conducted to better understand the problem of vitamin A deficiency in Tanzania. Two proposed activities were presented.

Public health measures in the control of vitamin A deficiency: a proposal for the control of intestinal parasites and schisto-

somiasis (bilharzia) (17). Intestinal helminths and schistosomiasis are prevalent in Tanzania. These parasites are an underlying cause of protein-energy malnutrition (PEM), anemia, and vitamin A deficiency and are among the top 10 health problems in the country. Children are most often infected.

In the past, the control of intestinal helminths and schistosomiasis depended on health education, provision of clean water, and improved sanitation. However, such programs demonstrated virtually no impact on the problem. With the availability of effective drugs (albendazole, anthelmintic, and praziquantel), a deworming program is being undertaken as a collaborative effort of the Ministry of Health; Ministry of Education and Culture; Ministry of Community Development, Women's Affairs and Children; local government; TFNC; Muhimbili Medical Centre; and some nongovernmental organizations.

In addition to drug therapy, the program includes micronutrient supplementation (including vitamin A) and participatory health education. Funding is expected to come from UNDP, Rockefeller Foundation, and the Child Survival Task Force.

Tea fortification with vitamin A: a proposed research plan (18). Tanzania plans to begin vitamin A fortification of a widely consumed food. Feasibility studies will be conducted for tea, vegetable oil, and sugar. Of the three foods, tea appears most suitable because it satisfies most of the criteria of a suitable vehicle: it is centrally processed and distributed by one company, it is a popular beverage consumed by the whole population including the target group (preschoolers and women), it is affordable, and fortification is technologically feasible and inexpensive. Furthermore, the tea company is willing to cooperate upon successful completion of feasibility studies.

Note: Reports of other activities for the control of vitamin A deficiency in Tanzania were given at a poster session. These included horticulture; information, education, and communication; diet diversification; preservation of vitamin A-rich foods by solar drying; production of red palm oil; and laboratory support. Abstracts of presentations during the national symposium are included in the abstracts section of this meeting report.

XV IVACG MEETING SCIENTIFIC PRESENTATIONS

Vitamin A Projects to Programs: What Does It Take?

Two key presentations were made during this session. In the first, Dr. James Greene (19) characterized the process of "scaling-up" projects to programs from an international perspective, and in the second, Dr. Festo Kavishe (20) described the evolution of the national program in Tanzania. These were followed by case studies from three countries: India (21), Brazil (22), and the Philippines (23).

AN INTERNATIONAL PERSPECTIVE

Dr. Greene (19) highlighted the key role of local delivery systems in making the transition from pilot projects to national programs that involve dietary diversification, supplementation, and fortification. Specifically, local systems must learn how to cope with scaling-up, especially in improving their infrastructure and organizational abilities. Two basic models for scaling-up were described: 1) organizational growth and 2) large-scale program expansion from small pilot projects.

Organizational growth usually involves an informal phase of building credibility and constituent support and of experimentation and team effort, with an evolution of practices that progressively define what is to be done. Later phases involve consolidating and defining more clearly the functional roles of management and operations as the organization expands. Scaling-up small projects, on the other hand, requires decisions about exactly which project elements are to be nationalized and which resources (physical, financial, and human) will be explicitly needed to expand to a program. It was argued that each model should demonstrate intervention effectiveness, feasibility, and efficiency under anticipated program conditions before going to scale with an appropriate mix of services and resources.

The choice of intervention will influence the mix of sectors that must collaborate in the context of a program. For example, whereas the scaling-up of vitamin A supplementation would remain within the health sector, central

food fortification would require active participation of private food industry and government regulatory agencies. Dietary change would likely involve agriculture, food, and education sectors.

THE TRANSITION PERIOD

During the "project to program" transition, there is a need to maintain constancy in the definition of the problem and in the measurement of deficiency. For example, adoption of new or different outcome indicators over time may confound efforts to monitor change and therefore program impact, or lead to redefining of both the program objectives and the target population.

The shift in emphasis from a single project intervention to a mix of interventions within a program changes the information needs for assessing effectiveness and the criteria for evaluating the impact of combined strategies. For example, adding components to a single intervention may be expected to improve overall effectiveness, but new criteria will be needed to judge whether the incremental costs justify the incremental gains in outcome.

As attention shifts from effectiveness and feasibility of projects to the operational costs and impact of programs, adequate planning, training, management and supervision, and flexibility to adapt to multicultural needs of a larger population become the determinants of program success. Supervision will need to be sensitive to levels of performance, consistent over time, flexible, frequent, and responsive.

The need for special monitoring and evaluation systems must be emphasized, as must the probable need for some form of continuing external assistance during the transition period, albeit perhaps on a declining scale until the program stabilizes.

Dr. Greene noted that the change in motivation to prevent vitamin A deficiency, i.e., from blindness prevention to include child survival, has strengthened the case for comprehensive and effective programs. Although effective interventions are available, decision making about their inclusion in programs should rest

Summary

on cost-effectiveness and efficiency considerations.

A NATIONAL EXAMPLE: TANZANIA

Dr. Kavishe (20) focused on the essential processes that shaped the development of a national vitamin A program, which included deciding how to advocate, mobilize resources, and secure early in the program the necessary political support and technical competence. Attention was placed on raising national awareness and establishing national goals with the assistance of international agencies. Efforts were made to narrow the gap between the availability of international resources and the national capacity to access and allocate such resources for vitamin A deficiency prevention. There was an early appreciation of the interaction between the biological and social factors in the genesis of vitamin A deficiency and the need for multidisciplinary and multisectoral approaches. Importantly, the necessary institutional bases for achieving sustained, effective action exist in Tanzania.

A national capacity for research was achieved through training and technology transfer with international collaboration. Pilot projects enabled an early appreciation of limits to the actual delivery of large-scale programs that effectively target groups at highest risk.

The first 5-year program, launched in 1988, employed targeted capsule distribution plus dietary approaches, both reinforced by strong information, education, and communication (IEC) support and delivered through the existing infrastructure. Supportive systems for management, monitoring, evaluation, and laboratory assessment were strengthened. The multisectoral National Vitamin A Consultative Group was formed to provide policy guidance and strategic oversight. It was necessary for the Tanzanian government to assure seed funding for the program, which was then able to attract external funding assistance. The modest achievements of the first program, coupled with the increased international focus on vitamin A, assured full funding of a second 5-year program by the World Bank. The following factors have contributed to the rapid development of the Tanzanian program:

1. the identification of a national lead agency, the Tanzania Food and Nutrition Centre (TFNC), to mobilize and organize resources and to coordinate program development, implementation, monitoring and evaluation, and development of the human resources capacity
2. consensus building across sectors and development of a comprehensive national plan of action through workshops, including the formation of a multisectoral working group whose political profile was assured by the participation of senior state officials
3. priority attention to human resource development and the collaboration of local planners with external counterparts to demystify the planning process and to reinforce national confidence about the adequacy of their own capabilities
4. strong, multimedia IEC support that was incorporated into preservice training curricula

The modest achievements of Tanzania indicate that progress can be made toward eliminating vitamin A deficiency without having to wait for the trickle-down effect of economic development.

CASE STUDIES: INDIA, BRAZIL, AND THE PHILIPPINES

There were recurrent themes in the case studies from India, Brazil, and the Philippines. All of them have had extensive experience with national programs that started from research initiatives to document and publicize the problem and to inform government of effective solutions. Advocacy led to greater awareness of the problem, a consensus to act, and a political commitment aimed at prevention.

India (21) started a national supplementation program in 1972. It was initially a vertical program but has since been integrated into the primary health care system. Disruptions in capsule supplies and weak IEC components have often resulted in low coverage. The need to refocus toward dietary interventions was long ago recognized and is now being fully pursued. New dietary sources of vitamin A are introduced, where practical, and conventional sources are actively promoted. While progress

has been made, it has been difficult to secure adequate funding to develop sustainable local options.

In Brazil (22), the program is organized and funded by the National Institute of Nutrition, Ministry of Health. Supplements delivery started in 1983, integrated with the national immunization system. Adoption of the program, however, is at the discretion of state and local governments, which must provide local logistic support. As a result, very few states have had continuous distribution over the years. This situation gives rise to concern about the stability of the program if changes in political leadership lead to changes in priorities.

In the Philippines (23), perseverance and continuing advocacy over the past 20 years have ensured political commitment and funding for vitamin A deficiency prevention. The program has been successful in linking multiple sectors together to address micronutrient deficiencies and in obtaining the collaboration of the commercial media, especially radio broadcasters, in communicating clear nutrition messages.

Vitamin A Programs: How Do We Know They Are Working?

Dr. John Mason (24) reviewed basic tenets of monitoring and evaluating programs, as well as the choice of indicators and program components to which they could be applied, to assess whether a program is reaching its pre-established goals. The importance of building monitoring systems into programs at the outset was noted. In practice, however, few programs have this provision, presumably because of funding constraints. A policy decision to continuously evaluate programs is required such that surveillance systems can be designed, budgeted for, and carried out as a core component of program packages.

Evaluation of impact is often a much larger, often separate and costly exercise that may not be necessary if impact has been demonstrated in pilot projects or if similar programs have been evaluated previously under representative conditions. Thus, monitoring "process" as well as intermediate status indicators is often adequate for programs. The mix of

interventions will determine which process indicators may be most suitable. Coverage is the commonest performance indicator applied in program evaluations, requiring careful definition of target groups.

Dr. Ignatius Tarwotjo (25) described the Indonesian program experience as it was originally designed and as it has since evolved into a multisectoral national program over the past 20 years. The program currently employs vitamin A supplementation, fortification (still on a regional and evaluative basis), and an array of dietary diversification measures through social marketing efforts. Preliminary findings were presented from a 14-year follow-up national xerophthalmia survey, carried out last year in Indonesia, which served to illustrate the use of pre- and postintervention comparisons for evaluating the impact of a program (26). The same sample sites as in a 1978 national xerophthalmia survey were revisited to determine changes in prevalence, to identify areas still harboring a xerophthalmia problem of public health significance, and to attempt to identify factors related to successful control. The evaluation noted reductions in prevalence of from 71 to 95%, leading to an inference that with the exception of some "pockets," xerophthalmia is now under control in Indonesia.

A lively discussion focused on the validity of pre- and postintervention comparisons, given that observed changes in outcome could be attributed to nonintervention and developmental factors. For example, in the case of Indonesia, attention was drawn to the nearly 66% reduction in the proportion of the population below the poverty line and to the increased measles immunization coverage during this intersurvey period. It was suggested that the interpretation of program impact could be enhanced by comparing areas covered by the program with areas not covered. The Indonesian data are currently undergoing analysis.

This discussion, however, also raised important questions about which types of surveillance indicators and cutoffs should be employed for deciding when, where, and how to phase out a short-term program, such as semiannual vitamin A supplementation, and replace it with longer-term strategies. Empha-

Summary

sis was placed on the need to carefully monitor status changes in a population undergoing program withdrawal or transition from short- to long-term (e.g., food-based) interventions.

Operational Issues

Oral and poster presentations throughout the meeting highlighted policy issues and reported program experiences at different points along the continuum of "testing the process" to "going to scale" (19). Papers dealt with community-based delivery of large doses of vitamin A (27-30) and the efficacy of vitamin A treatment and prophylaxis in high-risk target groups (31-36). However, in line with the clear need to address fundamental dietary causes of vitamin A deficiency, a number of papers focused on food-based and social marketing approaches to increase the supply and consumption of vitamin A-rich foods (28,37,38). Factors that affect vitamin A efforts within health care systems were highlighted (26,39,40). "Missed opportunities" (28) and "windows of opportunity" (27) were repeatedly identified with respect to integrating vitamin A interventions into existing health care and food-based strategies. Irrespective of the type of intervention, missed opportunities that are adequately characterized were viewed as windows of opportunity to improve coverage and effectiveness in the future.

VITAMIN A SUPPLEMENTATION

Periodic delivery of large oral doses of vitamin A comprises a major short-term strategy for controlling xerophthalmia in the community (41) and has been shown to effectively reduce mortality (42). Large-dose vitamin A therapy is also the primary treatment for xerophthalmia (43). Typically, the dosage is provided in capsular form, although the oily supplement may also be dispersed from a bottle, as in India, or by a canister.

Community-based vitamin A delivery is widely held to be unsustainable unless it can be targeted (30) and successfully integrated into health services such as growth monitoring (36), the Expanded Programme on Immunization (EPI) (44), and other primary health care programs (26,29,39,40). Careful analysis of decades of national program experience in

India shows that vitamin A supplementation in the community has been hampered by interruptions in supplies, inadequate supervision and coordination, and low levels of awareness and participation in the community (21). In Bangladesh, the effectiveness of large-dose vitamin A delivery is recognized, but it is equally apparent that a balanced strategy is one that concurrently develops effective, long-term approaches to diversify the diet of high-risk populations. Plans are needed for scaling down capsule distribution once dietary-based vitamin A strategies are in place and are deemed effective, as monitored by proper surveillance mechanisms (30).

Reports of capsule distribution at this meeting identified mechanisms of local delivery, as well as characteristics and practices of health care providers and (intended) recipients, that may affect program performance. In addition, supplement dosage levels were evaluated.

SYNERGISM BETWEEN THE COMMUNITY AND HEALTH PROVIDERS

Several studies in Southeast Asia observed a "synergism" in vitamin A capsule coverage when local health providers and the community worked together. A four-province survey in eastern Indonesia reported that over half (51%) of mothers and children regularly attended local health posts ("posyandu") when services were jointly provided by subdistrict health center staff ("puskesmas") and village-based posyandu staff; when either one alone operated a clinic, only 25-33% of mothers regularly attended (26). Other factors related to improved attendance were an active neighborhood women's group (dasa wisma), close proximity of a village to a puskesmas, education of the head of household, and the regularity of micronutrient (vitamin A and iron tablets) supplementation at the posyandu, emphasizing the need to meet supply and delivery requirements once "demand" has been created.

Similarly, in three provinces in the Philippines, teaming-up local leaders with rural health midwives to weigh children and periodically distribute vitamin A capsules led to increased participation in the national growth-monitoring program ("Operation Timbang")

and also increased capsule coverage (36).

Evaluation of a routine, district vitamin A delivery program in Central Java, Indonesia, revealed that ~70% of eligible preschool children had received vitamin A during two previous 6 monthly rounds; 58% received both capsules and 82% received at least one capsule. Coverage was higher in villages where the benefits of vitamin A had been previously discussed by health workers. It was felt that maternal knowledge of xerophthalmia and its consequences, and of the protective effect of vitamin A, may have influenced supplement receipt by children (29).

VITAMIN A AND THE WHO EXPANDED PROGRAMME ON IMMUNIZATION (EPI)

Experiences were reported on integrating vitamin A delivery with EPI services, which make ~500 million infant and mother contacts each year (44). Where EPI coverage is adequate and vitamin A deficiency is a public health problem, such a linkage permits mothers to be given a large dose of vitamin A soon after childbirth (along with the BCG vaccine when this occurs within the first postpartum month). It also allows infants to be reached, possibly with low doses of vitamin A, several times through the first year of life (e.g., with the DPT series and measles vaccine) (44). Early EPI contacts may provide timely opportunities to intervene given empirical evidence that breastfed infants may be receiving inadequate daily amounts of vitamin A from breast milk even before 6 months of age (45).

On Lombok, Indonesia, a Ministry of Health-nongovernmental organization pilot project to integrate vitamin A with the EPI in 18 villages was expanded over a 20 month period to 84 villages (30% of the island's population). During this time, the project dosed 77% of all postpartum women with a 200,000-IU vitamin A capsule. Eighty-five percent of all infants received a DPT-2 vaccine and 50,000-IU vitamin A at 10 weeks of age; 58% of the 78% of measles-vaccinated children at 9 months of age were also dosed with 50,000 IU. The outreach also appeared to stimulate a high level of coverage (84%) of older preschool children with 200,000 IU (46). Program costs and the degree of program compliance related to NGO

involvement were not reported.

The EPI as a "window of opportunity" appears to remain valid even where government programs run at lower levels of coverage and timeliness. In a district EPI survey in Ghana, ~40% of all infants received their DPT-3 and ~50% their measles vaccinations between 6 and 11 months of age, representing contact opportunities for vitamin A supplementation. An estimated 84% of children had received their measles vaccine by age 24 months, representing a clear opportunity to dose children at least once during the first 2 years of life. There was essentially no marginal cost in this district in Ghana of adding vitamin A to the EPI schedule beyond that of the capsule itself (US\$0.02) (27).

Concern has been raised about the safety of combining the administration of a moderately high dose of vitamin A (50,000 IU) with a vaccine (e.g., DPT series) in the first few months of life. During a clinical trial of 191 infants in Bangladesh, 11.5% of those who received vitamin A + DPT vaccine developed a bulging fontanel versus 1.1% of controls (placebo plus vaccine) ($p < 0.01$). Most bulges subsided within 24-48 hours, and all disappeared within 72 hours of dosing. No other differences in morbidity or irritability were observed (47). The reported frequency and relative risk of a bulging fontanel following this combined treatment was considerably higher than that recently reported from Nepal after infants had been given either 50,000 or 100,000 IU of vitamin A alone (48). The clinical significance of a transient bulge in the fontanel is unclear and was considered a point for further discussion. However, these findings suggest that a transient rise in intracranial pressure may be expected in some infants when 50,000 IU (and presumably more) of vitamin A is administered concurrently with the DPT vaccination.

VITAMIN A AND GROWTH MONITORING

"Under-5" growth monitoring represents another underutilized opportunity for vitamin A integration. In the Lower Shire Valley of Malawi, 91% of children 12-23 months of age had visited an under-5 clinic in the previous 6 months, but only 19% of these children had received vitamin A. Beyond age 3 years, un-

Summary

der 5 clinic attendance dropped and with it the opportunity to supplement older preschoolers. However, at each age, only ~20% of children who were weighed in the clinics had been dosed with vitamin A. In this culture, maternal knowledge of xerophthalmia and vitamin A did not influence coverage; rather, lack of consistent capsule supplies and inadequate national promotion of this strategy were deemed reasons why these "missed opportunities" had not yet been converted into vitamin A contacts (28).

VITAMIN A WITHIN PRIMARY HEALTH CARE SYSTEMS

Perhaps the largest "scaling-up" of an initial primary health care project into a full-scale health and nutrition program has occurred with the government of India's Integrated Child Development Services (ICDS) scheme. Initially begun in 100 villages in 1975, this community-based multiple-intervention program now reaches 12 million children and 2.3 million mothers in more than 210,000 villages. In contrast to typical declines in coverage, an interim evaluation covering the period 1984-1990 showed that the ICDS steadily increased its large-dose vitamin A coverage and registered decreases in xerophthalmia rates over this time period. These favorable outcomes have been attributed to innovative efforts to improve management, training, social marketing, and the delivery of services (39).

In Nepal, a large intervention project serving 54,000 children in seven districts evaluated two approaches for periodically delivering large doses of vitamin A: 1) through vertical delivery or 2) as part of primary health care activities (including deworming, oral rehydration, acute respiratory infection [ARI] treatment, and immunization). These strategies were compared with 3) an approach that involved nutrition education plus enhanced primary health care services and, to a limited extent, efforts to reduce maternal literacy and 4) a "control" group of villages in which children received only symptomatic treatment for eye signs through existing health posts. Capsule coverage averaged between 70 and 80% in the first two approaches, which were associated with a greater impact on xerophthalmia

and mortality reduction than were the last two. However, vitamin A delivery does little to correct the underlying risks that give rise to vitamin A deficiency (40).

PROTECTIVE EFFICACY: 200,000 VERSUS 100,000 IU

The duration of protection conferred by a 200,000- versus a 100,000-IU oral dose of vitamin A was compared in a randomized clinical trial among children 2-5 years of age in Indonesia (33). After 6 months, xerophthalmic and other high-risk children who received the larger dose had higher serum retinol levels, fewer positive relative dose-response (RDR) tests, and a lower Bitot's spot (X1B) relapse than did children who received 100,000 IU. The 200,000-IU dose was most protective in highest-risk children, i.e., among those who entered the trial with xerophthalmia (X1B), providing evidence to support the prophylactic use of the 200,000-IU dosage as currently recommended by the WHO (49).

SUPPLEMENTING GROUPS AT SPECIAL RISK WITH VITAMIN A

CHILDREN WITH SEVERE MEASLES

Several target groups were described for whom large-dose vitamin A therapy appears to be particularly effective. Previous clinical trials have shown that providing vitamin A (400,000 IU over 2 days) on admission can greatly reduce morbidity (50,51) and case-fatality rates (50,52) caused by severe measles. Nonconcurrent, prospective data presented from South Africa showed that such findings have relevance for routine hospital practice. By comparing hospitalized measles outcomes in two different time periods that appeared to differ only with respect to the use of large-dose vitamin A, investigators reported a 60% lower requirement for intensive care, 24% shorter hospital stays and a 68% lower case-fatality rate associated with vitamin A treatment. Cost savings were estimated to be \$200 per vitamin A-treated, hospitalized case (31).

The benefit of large-dose vitamin A therapy may also extend to outpatients. A second paper from Zambia reported results of a clinical trial among 200 children that evaluated the

effect of treating nonhospitalized measles cases with 200,000 IU of vitamin A on recovery from acute lower respiratory infection (ALRI) (based on respiratory rate). At baseline, 63% of the vitamin A-treated and 68% of placebo-treated children had ALRI. After 4 weeks, ALRI was absent in the vitamin A group whereas it persisted in 12% of controls (53).

INFANTS

Infants who are never breastfed or are weaned in the first few months of life face an excess risk of keratomalacia if weaning foods are devoid of vitamin A. Such foods, and especially nonfortified milk products, were implicated in recent outbreaks of severe infantile xerophthalmia in southern Thailand, southern India, and Northeast Brazil (45). Direct infant supplementation with either oral doses of vitamin A or vitamin A-fortified weaning foods could protect these high-risk infants. However, breastfeeding still may not confer adequate protection in certain breastfeeding populations after 4–6 months of age, as evidenced by clear reductions in mortality when infants are dosed with vitamin A in the second 6 months of life (42,45). Corrective action could include giving mothers a large dose of vitamin A (e.g., 200,000 IU) within 1 month of birth (to enrich breast milk) or direct infant supplementation (e.g., through the EPI) (44,45). However, there is no evidence that large-dose vitamin A supplementation below 4 months of age confers a child survival benefit in breastfeeding populations (54,55).

LACTATING MOTHERS

Lactating women in the immediate postpartum period may be a target group for intervention, to improve both their own vitamin A nutriture and that of their infants through breastfeeding. In Indonesia, a 300,000-IU oral supplement of vitamin A given to mothers within 3 weeks postpartum significantly increased breast milk retinol levels for the next 7 months and improved the vitamin A status of their infants (by serum retinol and RDR indicators) at 6 months of age versus controls (32). These findings are programmatically relevant given the Lombok Island, Indonesia, experience of reaching ~75% of women with a 200,000-IU vitamin A supplement within 1

month of birth during routine EPI contact (46).

OTHER HIGH-RISK GROUPS OF CHILDREN

Studies in Nepal reported, for the first time, that 200,000 IU of vitamin A given every 6 months was protective against both xerophthalmia and mortality in school-aged children (35), although the absolute risk reduction is greater in younger children owing to the higher number of avertable deaths in the preschool years (42). A report from Zimbabwe underscored the importance of vitamin A supplementation in protecting refugees from deficiency, particularly where rations may lack adequate amounts of the nutrient (34).

Dietary Diversification Strategies

FOOD-BASED STRATEGIES TO INCREASE VITAMIN A FOOD AVAILABILITY AND CONSUMPTION

Food-based strategies to prevent vitamin A deficiency emphasize the production, processing, preservation, and consumption of beta-carotene-rich foods (56,57). A number of presentations advanced the premise that the food-based approach is a strategy whose time has come, since it aims to correct the underlying dietary causes of vitamin A deficiency. The importance of this approach is underscored by the recent commitment of 159 countries to develop food-based strategies to meet micronutrient needs as set forth in the World Declaration and Plan of Action that was adopted at the ICN (58) and embodied in the 1991 policy statement of FAO on the use of nutrient-rich foods to prevent micronutrient deficiencies (56).

Several papers reported findings from various food-based intervention projects. In Coimbatore (Tamil Nadu), India, regular provision of small amounts of papaya and drumstick leaves coupled with nutrition education over a period of 1 year measurably improved child, mother, and general family diets with respect to beta-carotene intake. Child vitamin A status (by serum retinol) rose to a level that was apparently similar to that achieved with oral vitamin A supplementation (59). Another study in Tamil Nadu, carried out in 20 schools participating in the statewide 9 million-child noontime school meal program, evaluated the

Summary

effects of 12 months of nutrition education that emphasized vitamin A-rich foods. The prevalence of xerophthalmia decreased from 7 to 2%, and mothers of children increased their "awareness scores" from 56 to 70%. These changes were attributed to a tendency for children to carry home the nutrition messages that affected food availability and consumption at home (60). It would appear that these and other similar strategies should be evaluated in controlled trials.

Increased attention is being given to raising vitamin A intake through sustainable and effective gardening initiatives. A new four-province, FAO-government project in Vietnam will identify, propagate, and promote the production and consumption of suitable species and varieties of horticultural crops for home gardening. Each site represents a different agroenvironmental zone in order to develop locally relevant crop mixes. The project views training and establishing linkages across local sectors, including health and agriculture, as critical to its success (61). The Asian Vegetable Research and Development Center (AVRDC) has long championed a 4×4-square-meter home garden that has been developed for several Southeast Asian countries that meets the nutritional needs (i.e., vitamins A and C, iron, and calcium) of a family of five, although sustainability has been difficult to achieve (62). An evaluation of a home gardening project in Bangladesh showed that the frequency of consumption of vegetables by preschool children was strongly and positively influenced by the variety of vegetables grown in the garden, after adjusting for multiple educational and socioeconomic factors. Vegetable consumption also rose with child age and level of maternal education (63).

Advances were also reported on local ways to process and preserve vitamin A-rich foods. In Guatemala, "instantized" sweet potato buds have been locally processed, analyzed, and tested for acceptability in the forms of gruel, puree, cakes, and other dishes. Rural/urban preferences existed with respect to recipes, but overall acceptance was very high (~90%). The yield was 11% from fresh sweet potatoes. Initial beta-carotene content was twice that of fresh sweet potatoes although there

were 48 and 69% losses after 4 and 5 months, respectively. Efforts are under way to resolve issues related to packaging, reconstitution, shelf life, and marketing that may lead to greater consumption of a local beta-carotene-rich food (64). Leaf concentrate has been developed on a pilot basis in India over the past several years, producing ~10% yield by weight from fresh green leaves. One teaspoon of leaf concentrate (10 g) delivers a full day's vitamin A allowance plus appreciable quantities of other micronutrients (65).

Solar drying has long been recognized as a local means to preserve and extend the availability of seasonal fruits and vegetables. The Vitamin A Field Support Project (VITAL) unveiled several solar dryers of different sizes, all constructable from local materials at low cost, that minimize drying time (by their heat conductance and air convection properties) and achieve up to 50–80% vitamin A retention (66). During the meeting, samples of mangoes were prepared and dried in the midday sun to ~18% moisture content, with excellent results. The driers have undergone extensive testing in Haiti and the Dominican Republic, with local agencies and women's groups developing recipes for the dried produce. In these tests, vitamin A retention after 4–6 months remained high (e.g., ~1100 RE (retinol equivalents) per 100 g of squash and mango, ~4000 RE per 100 g of carrots and spinach) (67). In Senegal, mangoes that were solar dried in a direct-indirect model dryer for 24–30 hours achieved lower moisture content (8–10%) and a similar level of vitamin A retention (~700 RE per 100 g) as well as appreciable retention of vitamin C (19–45 mg per 100 g) (68).

During the discussion, concerns were raised about the considerable investment of time and labor to develop home gardens, which often do not produce sufficient yields to make gardening projects appear sustainable. It was considered more encouraging to begin with a few known, easily grown varieties and, only after interest has taken hold, add more appropriate varieties.

COMMUNICATIONS AND SOCIAL MARKETING STRATEGIES TO DIVERSIFY THE DIET

A communications strategy aimed at increas-

ing vegetable and fruit availability (through gardening, improved markets, and food purchasing) and consumption among vulnerable groups needs to be comprehensive. It should take into consideration issues related to audience definition and segmentation, "product" development, promotion, price, and distribution (38), and should include plans for adapting elements that are shown to be effective and sustainable into programs (37).

Experiences of Helen Keller International (HKI) in Indonesia, the Philippines, and Bangladesh highlight the need to reach the (as yet) unreached with social marketing initiatives. All three HKI projects increased exposure of target communities to messages introduced through a variety of media. Before/after evaluations registered improved maternal knowledge and attitudes as well as preschool child eating practices in each country. However, behavioral change did not parallel the high and continuous level of message delivery in the community. These observations point toward an "unfinished agenda" for social marketing that should pay greater attention to subgroups classified by their readiness to change and to develop messages tailored to their state of readiness. Other items of the agenda include the need to understand both the personal values of potential beneficiaries and the reasons for unresponsiveness to behavior change messages among the vulnerable (38).

The Worldview initiative in northwestern Bangladesh offers an example of NGOs, research institutions, and local communities jointly working to control vitamin A deficiency through communications (37). It also shows how a pilot project has been incrementally scaling-up over the past decade to become a full "program." In 1984, a pilot project set out to raise community awareness of night blindness and its causes and to control it through increased gardening and consumption of vitamin A-rich vegetables and fruits. Promotional messages penetrated target communities through schools, folk singing, radio, cinema, and (to the extent possible) television spots, a documentary film, billboard advertisements, pictorial print material, and government and NGO worker contacts with the community.

Periodic evaluations by research centers in Bangladesh measured the project's achievements of specified targets; suggested program elements to add (e.g., organizing vulnerable women into mothers' groups), modify, or delete; and provided guidelines for sustainable expansion. The multimedia program presently reaches a population of 4 million in 21 sub-districts. Estimated intakes of dark green leafy vegetables (DGLV) have increased, and the monitored prevalence of night blindness has decreased. The project provides tangible evidence of progress and economies of scale that can be achieved when a well-orchestrated communications effort is scaled-up over a period of a decade.

In her summary of dietary behavior studies, Ms. Suttalak Smitisiri highlighted five key points (69):

1. The increasing number of success stories from studies or projects, and the diversity of approaches for changing dietary behavior, indicate a large potential for achievement by this strategy.
2. Both qualitative and quantitative data on food habits in communities need to be obtained and considered in planning dietary programs.
3. Effective and multipronged approaches are required for nutrition education.
4. Legitimate concerns about the sustainability of home vegetable production must be addressed.
5. Commercial challenges to marketing and promoting new nutrient-rich foods need attention; it is insufficient to concentrate only on the technological challenges of production.

Methodologic Issues in Assessing Vitamin A Status

INDICATORS OF VITAMIN A STATUS: AN OVERVIEW

Professor James Olson opened the session with a brief overview of methods of vitamin A status assessment (70). Indicators were broadly classified as biochemical, clinical, and other types that, singly or combined, reflect a spectrum of status that can be classified as deficient, marginal, satisfactory, excessive, or toxic. The biochemical indicators derive from

Summary

isotope dilution methods (which assess the total body pool of vitamin A); retinol levels in plasma, breast milk, and tear fluid; and response assays such as the RDR, modified RDR, RBP response, and a 1-month plasma retinol response. Dr. Olson reviewed the applicability and reliability of these status indicators. Clinical indicators relate specifically to ocular signs and symptoms. Note was made of the low prevalence of clinical deficiency in most populations and hence the need for large sample sizes for estimation. Some lesions (i.e., X1B) may also be nonresponsive to vitamin A treatment, necessitating caution when cross-sectional findings are interpreted. Other types of indicators range from qualitative physiologic measures, such as subjective dark adaptation and history of night blindness, to more quantifiable indicators such as vision restoration time and impression cytologic status. Dietary indicators can be either qualitative or quantitative and may serve as a proxy for population risk of dietary inadequacy. Importantly, there is a clear need to specify the purpose and assess the utility of indicators in specific situations.

CLINICAL AND HISTOLOGICAL METHODS OF ASSESSMENT

In summarizing papers on clinical and histologic assessment of vitamin A status, Professor Alfred Sommer provided an overview of the basis for these methods and their application, strengths, and limitations (71). These methods include clinical evaluation for xerophthalmia, cytohistologic assessment of the conjunctiva (72-74), and functional assessment of scotopic vision by dark adaptometry (75). All reflect the consequences of poor vitamin A nutriture by measuring physiological abnormalities at the target tissue level. By definition, therefore, they describe postdepletion events. As measures of population status, a number of surveys indicate that they correspond well with biochemical indicators of vitamin A status (i.e., in terms of prevalence estimation) (72,74).

Conjunctival impression cytology (CIC), or impression cytology with transfer (ICT), which identify early histological changes on the surface of the eye associated with vitamin A deficiency, is simple, atraumatic, and inexpensive.

However, CIC abnormalities can persist even after restoration of vitamin A nutriture, thus bringing its use for program evaluation into question. A number of issues remain unresolved with respect to interpretation of CIC specimens. In Ghana, reproducibility in interpretation was markedly improved by discounting mucin spots, which provided estimates of abnormality that were comparable with those based on biochemical indicators, although individual children were not similarly classified (72). A study from Mali using the modified ICT technique suggested that false-positive rates may be high (e.g., reflected by a twofold increase in region-specific prevalence) in areas with endemic, chronic inflammatory diseases such as trachoma (73). It may therefore be necessary to assess trachoma status in populations where this disease is known to occur and to adjust estimates of CIC abnormality prevalence by this factor.

Compared with biochemical methods, rapid dark adaptation was shown to have higher sensitivity and specificity than did night blindness. Efforts are under way to develop new techniques that will permit its use in children. A prototype dark adaptometer was presented in a study from Indonesia. This test objectively measures the afferent pupillary reflex to light stimuli near the visual threshold using a hand-held illuminator, currently with 12 intensity settings. The technique is relatively simple and quantitative, and early tests suggest that it is sensitive to changes in vitamin A status (75). However, it must be performed under dark-adapted conditions (in a dark room or at night) and still requires further testing.

BIOCHEMICAL METHODS OF ASSESSMENT

Papers addressing biochemical assessment, and summarized by Dr. David Ross (76), examined new assessment techniques, the effect of infection on serum retinol levels, RDR and modified RDR performance, and the ability of serum retinol to predict xerophthalmia risk.

A study in Zambia evaluated the stability of vitamin A-circulating complex in spots of dried serum samples absorbed on filter paper. An almost perfect correlation was observed be-

tween levels of samples analyzed immediately and 5 weeks later ($r = 0.98$). If further tests prove successful, this and similar filter paper-based methods under development could greatly reduce the risk of specimen loss and expense related to storage and handling of serum and blood specimens (77).

Static serum retinol levels obtained in populations where infection is widely prevalent require careful interpretation. During the Ghana Vitamin A Supplementation Trials (VAST) baseline morbidity survey, a combination of clinically apparent and occult infection (including asymptomatic malaria parasitemia), reflected by raised titers of acute-phase proteins, accounted for up to 24% of all depressed serum retinol levels (78). These data also raise questions about the interpretation of serum retinol-based RDRs in such populations.

A study in Indonesia compared the RDR, modified RDR and CIC tests in two distinct socioeconomic settings: an economically deprived village and a relatively advantaged, well-nourished village. The prevalence estimates derived from modified RDR and CIC were comparable, although individual correlation was poor. The RDR and modified RDR provided comparable prevalence estimates only after the test dose was raised from the currently recommended 450 mg to 1000 mg of vitamin A (79).

Two studies in India (80) and Indonesia (81) evaluated the response of the modified RDR to vitamin A supplementation and the proposed cutoffs for classifying subjects by the modified RDR. In India, 24 school-aged children underwent baseline assessment, received 600 mg of vitamin A daily for 2 months, and were then reassessed. A cutoff for the dihydroretinol/retinol (DR/R) ratio of 0.047 was correctly classified for all supplemented children (80). In the final treatment cycle of the MORVITA trial in Indonesia, 257 high-dose vitamin A recipients and 289 controls were evaluated. The initially proposed DR/R cutoff of 0.03 misclassified more than 60% of supplemented children as marginally deficient (81). Both of these studies suggest the need to revise upward the DR/R cutoff for classifying subjects as deficient.

In a population-based study in Indonesia, a

serum retinol level below 20 mg/dL adequately predicted the presence of xerophthalmia in a community. It was noted, however, that it is unlikely that serum retinol, which is costlier and logistically more difficult to obtain, would be used as a surrogate for xerophthalmia (82).

OTHER PROXY METHODS OF ASSESSMENT

A unique study explored the hypothesis that traditional agricultural communities moving toward market-oriented economic development go through a vulnerable time period in which families are at increased health risks. The study correlated the prevalence of micronutrient deficiency with a composite development score and found higher rates of deficiencies in villages that were in transition. It was suggested that these development indices could be used as proxy indicators of risk, for purposes of targeting, based on anticipation of risk rather than on direct status assessment from surveys (83).

Methodologic Issues in Assessing Dietary Vitamin A Intake

Dr. Suraiya Ismail summarized papers on dietary methods of assessment for vitamin A deficiency. Dietary assessment is conducted to 1) identify dietary causes of low vitamin A status, 2) estimate the prevalence of low vitamin A intake and identify groups at risk of dietary inadequacy, and 3) evaluate individual intakes for purposes of diet therapy or modification. Meeting these goals can enable food-based programs to be appropriately designed, targeted, monitored, and evaluated. Dietary assessment methods range from intensive qualitative and quantitative methods to rapid-assessment approaches. Problems related to recall bias, sampling error, portion size estimation, and food composition table inaccuracies are general to any dietary assessment. Particular difficulties regarding dietary vitamin A assessment involve the nonavailability of food composition data for specific carotenoids and limited information on the roles of food preparation, storage, other dietary constituents (such as fat), and infection on food carotenoid bioavailability. Most dietary methods have not been validated, representing a

Summary

future area of work.

Two methods, both designed to identify groups and not individuals at risk, were discussed in detail: 1) the "IVACG method," which incorporates a 24-hour recall with a semiquantitative, 30-day food frequency to estimate scores based on the vitamin A content of specific portion sizes (84), and 2) what was called the "HKI method," which is more qualitative and employs a 7-day food frequency questionnaire. Two papers reported using both methods in a number of field surveys, and three studies described their performance in identifying high-risk individuals or groups.

The VITAL projects applied the IVACG method to 11 country surveys (85-87) and noted several problems, including recall bias in 30-day food frequencies, inappropriate weighting factors for portion sizes, unclear question formats, and imprecise guidelines. However, experience with the IVACG method has been valuable, and a number of modifications have been suggested based on these experiences.

The ability of the HKI frequency method to correctly identify communities at risk was evaluated in 15 randomly selected villages in high-risk regions, five each in the Philippines, Guatemala, and Tanzania, based on concurrently measured serum retinol levels (i.e., high risk = >15% prevalence <20 mg/dL). Eleven of the 15 communities were correctly classified: seven of the eight high-risk communities and four of the seven low-risk communities were correctly classified (88). This suggests that dietary intake frequency profiles of communities may be useful in identifying endemically vitamin A-deficient communities. However, individual associations between estimated intake and status remain weak. In Indonesia, a study compared intakes by both the IVACG and HKI methods against ocular status, RDR, and serum retinol levels. Surprisingly, the IVACG 24-hour recall tended to correctly classify children at moderate risk and showed a positive correlation between intake and serum retinol (although not with ocular status or RDR), whereas neither of the two food frequency methods (IVACG or HKI) was associated with vitamin A status indicators (89).

Other dietary methods were described. In a

study of lactating mothers in Central Java, dietary data obtained by an investigator-designed food frequency instrument was compared with serum and breast milk retinol status. Vitamin A intake from three foods (carrots, joint fir leaves, and swamp cabbage) was found to better explain the variance of serum and breast milk retinol levels than did total vitamin A intake from all foods (90). Thus, it may be possible to develop culture-specific short dietary instruments for surveys that could achieve acceptable precision, reduce interviewer and respondent fatigue, and simplify data management and analysis.

A second diet frequency questionnaire administered to women in West Java, which incorporated data on both portion size and type of recipe in which a food was consumed, produced a dose-response relationship between estimated vitamin A intake and serum retinol concentration in both lactating and nonlactating women. Other findings of interest were that lactating women consumed more vitamin A than did nonlactating women, vitamin A intake was unrelated to energy intake, and serum retinol was positively related to the proportion of dietary vitamin A intake from preformed sources (91).

It was concluded that 1) simplified methods require more location- and culture-specific validation against measures of vitamin A status; 2) simplified methods become rapid assessment methods only after considerable investment in design, field testing, and analysis to identify the most discriminating foods; 3) dietary assessment may be useful for ascertaining relative intakes of individuals and for screening at-risk populations (providing information for program targeting, selection, and design); and 4) there is a continuing need to improve food composition tables.

Vitamin A Status and Dietary Intake Surveys: Update

During the meeting, a number of papers reported new data on vitamin A status and intakes of representative or selected population groups. These were reviewed by Dr. Rodolfo Florentino (92). Basic summaries of these surveys are found in Table 1.

VITAMIN A STATUS SURVEYS

New findings of unpublished vitamin A status surveys, either statistically representative or carried out as baseline surveys for community trials and other evaluations, were reported from a number of countries in Asia, the South Pacific, Africa, Central America, and the Caribbean regions. Only prevalences of xerophthalmia or of low-deficient (<0.70 μmol/L) and deficient (<0.35 μmol/L) levels of serum retinol are summarized in Table 1. Xerophthalmia prevalence rates of ~3% in Nepal (35,40,93) are consistent with rates observed elsewhere in South and Southeast Asia where effective vitamin A interventions are not yet in place. A new maternal survey in Indonesia has reported that only 0.34% of children have X1B, all of whom were concentrated in only two provinces (94). Surveys in the South Pacific (85) indicate that xerophthalmia is occurring in several areas (e.g., Solomon Islands, and previously reported in Kiribati and Micronesia).

Surveys in seven African countries demonstrate a clear vitamin A deficiency problem

with an epidemiologic profile that tends to differ from that of South Asia: i.e., relatively low prevalences of (predominantly mild) xerophthalmia in the presence of high rates of subclinical vitamin A deficiency determined either biochemically or histologically. Surveys in Senegal (95) and Ghana (96) reported that ~70% of preschool-aged children had serum retinol levels below 0.70 μmol/L (<20 mg/dL). Fifty-five percent of the surveyed Senegalese children also had low serum total carotenoids (<0.70 μmol/L). Clinical signs were not reported in Senegal and were infrequent in Ghana (<0.2%) (P. Arthur, personal communication). In Cameroon, 22% of children had serum retinol levels below 0.70 μmol/L, with X1B observed in only 0.5% of children (97). In urban Mozambique, serum retinol was not assessed but only 0.7% had xerophthalmia, which was more strongly associated with recent acute stress (e.g., acute protein-energy malnutrition, displacement) than with dietary intake of vitamin A (98). A survey in Mali reported a trachoma-adjusted abnormal ICT rate, reflecting

Table 1. Summary of Reported Preschool Child Vitamin A Status and Dietary Intake Surveys

Country/region (reference)	n	Age (months)	Serum Retinol (μmol/L)		Xerophthalmia		Moderate to High Risk of Poor Intake ¹	
			<0.70 (%)	<0.35 (%)	All Stages (%)	X1B (%)	CI (%)	UPF (%)
South Pacific								
Solomon Islands (85)		6-83			1.5			
Tuvalu (85)		6-83			0			
Vanuatu (85)		6-83			0			
Cook Islands (85)		6-83			0			
South Asia								
Indonesia (94)	18508	<72			0.47	0.34		
Nepal (93)		12-60			3.4			
Africa								
Cameroon (97)	5000	<72	22		0.6	0.5		54
Ghana (96)	1175	0-59	73	16				
Mozambique (urban) (98)	10267	6-72			0.7			
Senegal (95)	271	24-48	70	7				
South Africa (urban) (99)	190	36-83	44	5	0			
Uganda (100)	5074	6-71			2.2			
Uganda (103)	210	<72						63
Central America/ Caribbean								
Dominican Republic (87)	648	12-71	10	4			31 94 ²	44 84 ²
Panama (101)	1600	12-59	6 13 ³	2 ³			47 63 ³	37 51 ³

¹IVACG method; CI = consumption index; UPF = "usual pattern of food consumption" score.

²Excluding seasonal mango intake.

³Subset of indigenous children.

Summary

subclinical vitamin A deficiency, of 47% (73). In a representative survey of an urban settlement in Durban, South Africa, 44% of 190 children had serum retinol levels below 20 mg/dL but none had xerophthalmia (99). However, a recent survey in Uganda found significant active xerophthalmia (2.2%) and an alarmingly high rate of visually disabling corneal scars attributed to xerophthalmia (16.8 per 1000) (100).

Xerophthalmia was not observed in the Dominican Republic (87) or in Panama (101), but 20 and 6%, respectively, of children had serum retinol levels below 0.70 $\mu\text{mol/L}$. Most of the vitamin A deficiency in Panama was observed among indigenous groups in whom 13 and 47% had serum levels below 0.70 (low to deficient) and 1.05 (marginal to deficient) $\mu\text{mol/L}$, respectively. Reported vitamin A intakes of these groups were also low. These findings are consistent with a pattern of discernible vitamin A deficiency in certain areas of Central America and the Caribbean in the general absence of xerophthalmia.

DIETARY VITAMIN A INTAKE SURVEYS

Cross-sectional dietary surveys and population-based longitudinal dietary studies of children conducted in several countries reported dietary findings either alone (86,102,103) or in conjunction with clinical (85,93,96-98) or biochemical (87,96,97,101) data on vitamin A status. A number of dietary assessments were based on the IVACG guidelines (84) and reported results as percentages of children whose estimated intakes suggested a moderate to high risk of inadequate intake based on "consumption index" or "usual pattern of food consumption" (UPF) scores (84). The results of these studies, summarized in Table 1, indicate that in each of the countries where scores were reported (Cameroon, Uganda, Dominican Republic, and Panama), 31 to 91% of children were classified as being at moderate to high risk of inadequate vitamin A intake, which tended to vary by country, season, and ethnic group. The UPF score-based prevalences were roughly two to six times higher than prevalences of serum retinol below 0.70 $\mu\text{mol/L}$ (87,97,101). Based on similar consumption index and UPF within-country estimates in these

studies, it is unclear whether computing both of these scores would be useful.

The relationship between dietary vitamin A intake and vitamin A status is highly variable. It can fluctuate according to type of instrument, period covered, frequency of assessment, worker variability, food composition table accuracy, type of status indicator, and other influences. Thus, modest associations between intake and status at the individual level, as reported in several studies (85,89,96,98), may relate to any number of these factors. One food behavior that is consistently shown to be protective against xerophthalmia and vitamin A deficiency is breastfeeding, as was again observed in Nepal (93) and in the Philippines (104). In Indonesia, breast milk was shown to be the richest source of dietary vitamin A in the infant's diet (102). Of particular interest, the Ghana VAST morbidity study found that the presence of a mango tree in the house compound was independently associated with higher retinol levels in children (96), providing a time-stable indicator of seasonal availability and intake of an important source of carotene.

Vitamin A and Child Mortality

RECENT COMMUNITY TRIALS

Two recent mortality trials that have been completed since the XIV IVACG Meeting in Ecuador were presented at the meeting: the Ghana VAST mortality study and the early infant mortality trial in Sarlahi, Nepal.

The study in Ghana was a cluster-randomized, double-blind placebo-controlled trial of 22,721 children aged 6-95 months, with 4 monthly administration of supplements (105). It was conducted in a rural area in the savannah belt of the country, on the border with Burkina Faso, in an area of low xerophthalmia prevalence but moderately high rates of subclinical vitamin A deficiency. Two independent mortality surveillance systems were employed: through 4 monthly home visits by trained field staff and through a system of community key informants. Cause of death was ascertained during verbal postmortem interviews. The trial noted an 18% (95% confidence interval: 3-31%) reduction in mortality

in children living in the clusters that received vitamin A compared with controls, and there were no age or gender differences in the size of effect. Reductions were observed for deaths caused by diarrhea and measles and for other causes of death, but not for pneumonia and malaria. These results indicate that reductions in mortality can be expected from improving the vitamin A intake of young children in vitamin A-deficient areas but where xerophthalmia rarely occurs.

The trial among young infants in Sarlahi, Nepal, was an extension of the previously reported study in which a 30% reduction in mortality had been observed among children 6 months of age and older (106). The present randomized clinical trial evaluated the impact on mortality of supplementing infants under 6 months of age with vitamin A (54). A total of 12,784 infants were enrolled over a 24 month period and supplemented every 4 months until they were >6 months of age (when they entered the older-child trial during the first year or, in the second year, were censored and dosed with vitamin A). Infants under 1 month of age received either 50,000 or 250 IU of vitamin A, and infants 1–5 months of age received 100,000 or 500 IU. Data for the first 16 months of follow-up showed no difference in mortality rates in the two groups of infants (relative risk [RR]=1.01), but by the end of the trial (at 24 months), a slight excess in mortality was observed in the vitamin A group (RR=1.11; 95% confidence interval [CI]: 0.86–1.42). A relative risk above 1.0 was observed for those dosed between 0 and 4 months of age, after which a protective effect became apparent. These findings suggest that no reduction in mortality can be expected by supplementing infants under 5 months of age with large doses of vitamin A.

META-ANALYSIS OF MAJOR VITAMIN A TRIALS

Findings from these and other previously published trials were recently submitted to a comprehensive meta-analysis on the effectiveness of vitamin A supplementation in reducing child morbidity and mortality (42). Dr. George Beaton presented the overview methods and key findings and discussed some of

the policy and program implications. The meta-analysis, which included eight out of 10 formal field trials, obtained a 23% reduction in mortality (95% CI: 15–29%) for children ~6 to 72 months of age. An estimated 95% prediction interval, reflecting a range of impact that could be expected in programs, is 1 to 40% (Figure 1). This suggests that results comparable to those seen in the Sudan (107) or Hyderabad (108) (where no effect was observed) or Madurai (109) (where a 54% reduction was noted), though possible, would be unlikely.

While the relative effect of vitamin A was found to be independent of age (after 6 months) or gender, there appear to be levels of impact by different attributed causes of death; i.e., it was strongly protective for diarrheal disease and measles but undetectable for deaths resulting from respiratory infection. Variation in effect could not be explained by differences in baseline prevalences of xerophthalmia or malnutrition or in control group mortality rates (42).

Variation in the conduct of the morbidity studies did not allow a formal meta-analysis, although the review did not find a consistent effect on the incidence or duration of illness. There was, however, suggestive evidence of a reduction in the severity of illness. Thus, vitamin A appears to influence the response to infection rather than resistance to acquiring infection (42).

During the discussion, it was noted that the most consistent impact across studies had been on deaths attributed to diarrhea and measles, for both of which there are efficacious and specific interventions (e.g., oral rehydration therapy and immunization). Thus, one could expect a lower impact of vitamin A where these interventions are adequately operating. The lack of impact in the Sarlahi trial in a population where breastfeeding was universal may not apply in cultures where infants are weaned from the breast early. Also, it is not known whether early supplementation may lead to a nutritional benefit in later infancy or childhood. Finally, the lack of benefit of vitamin A with respect to deaths related to acute lower respiratory infection (ALRI) was noted, the reasons for which are not understood.

Summary

Vitamin A and Child Morbidity

Vitamin A supplementation (by different means) reduces child mortality in cultures where diarrheal and respiratory diseases are leading causes of death (42). This leads to an inference, supported by presentations at this meeting, that vitamin A deficiency predisposes children to severe infection—and vice versa—and that the severity of certain infections can be reduced by improving vitamin A nutriture (111). This raises questions about the intermediate effects of vitamin A on host resistance and the risk of developing clinically apparent infection.

VITAMIN A AND SEVERE INFECTION

A case-control study in South Africa observed that children hospitalized with severe acute respiratory infection (ARI) had markedly lower serum retinol levels (13.8 mg/dL) on admission compared with nonhospitalized children with mild ARI (20.3 mg/dL) or hospitalized surgical controls (22.2 mg/dL) (111). Similarly, children hospitalized in Togo with acute diarrhea had significantly lower concentrations of retinol, retinol-binding protein, beta-carotene, and prealbumin compared with age-matched controls (112). The direction of association in these studies could not be de-

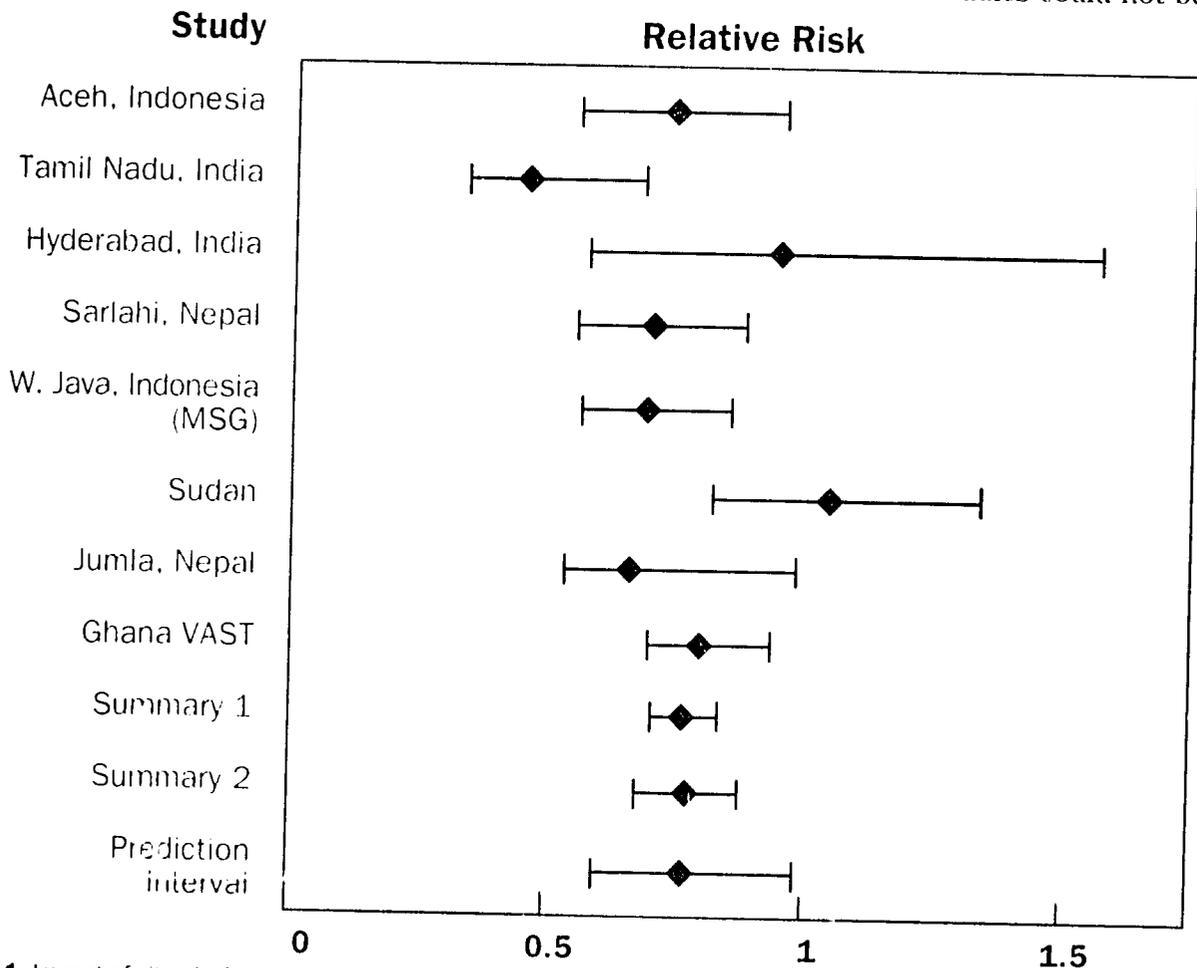


Figure 1. Impact of vitamin A supplementation on mortality of infants and children 6 months to 5 years. Shown are the point estimates and 95% confidence intervals for eight original studies reviewed in detail. The relative risk is marked by the diamond, and the confidence interval is indicated by the rule. Also shown are two summary estimates for the relative effect, taking into account all eight studies. These have the same point estimates, a 23% reduction in mortality, but differ in the estimated confidence intervals. The second estimate (Summary 2) takes into account the between-study variation that is believed to exist. Technically, it is derived from a random-effects model. The prediction interval for a future program or study is also presented. Again, the predicted average effect is 23%, but the interval describing possible actual effects is greatly expanded (see text for explanation). Study variances were adjusted for cluster sampling effects.

Source: G.H. Beaton, R. Martorell, K.A. L'Abbé, B. Edmonston, G. McCabe, A.C. Ross and B. Harvey, *Effectiveness of Vitamin A Supplementation in the Control of Young Child Morbidity and Mortality in Developing Countries: Summary Report* (University of Toronto, 1992), 3. Used with permission.

terminated, but it is likely that severe infection depresses vitamin A levels, which may in turn exacerbate the severity of infection (111). This also appears to have been the case in a cohort of drug users in Baltimore in whom HIV-1 seropositivity was associated with hyporetinemia, which in turn was associated with lower CD4 levels and an increased risk of AIDS-related infectious disease mortality (odds ratio [OR]=11.5) (113). Vitamin A therapy may be expected to modulate the severity of infection, as has been shown with measles (31,50–53), although this needs further inquiry.

A RCT among 1240 Brazilian children reported a 6% decrease in diarrheal incidence (95% CI: 2–10%) following large-dose vitamin A supplementation. The level of protection appeared to increase with severity of illness, reflected by rate ratios of 0.90, 0.80, and 0.77 (all $p < 0.05$) for diarrheal episodes with 4, 5, and 6 motions per 24 hours, respectively. However, there was no impact on the incidence, duration, or severity of respiratory disease (114).

The impact on morbidity of 4-monthly vitamin A supplementation among children 6–59 months of age was reported from Ghana (115). A cohort of 1455 children was randomized to receive a large dose of vitamin A or placebo and was followed weekly at home for a year. A clinic and hospital surveillance system was also implemented. Weekly morbidity for most symptoms was similar between groups. However, diarrheal episodes were reported by parents to be less severe (less dehydration, lower frequency of sunken eyes and drowsiness), and workers observed less frequently signs often associated with ALRI (wheeze, stridor, respiratory noise, rapid breathing, vomiting, fever, and refusal of food or breast milk). The more severe the signs and symptoms, the greater the protective effect. Clinic and hospital data supported this observation: clinic attendances were down 12% ($p=0.02$) and hospital admissions decreased 38% ($p=0.02$) in the vitamin A versus the control group. Beyond helping to clarify the clinical response to vitamin A, this study indicated that the control of vitamin A deficiency may significantly reduce demand on health care services (110,115).

VITAMIN A AND MILD INFECTION

A population-based xerophthalmia survey of 5074 children 6–71 months of age in Uganda found that children with xerophthalmia were more likely to have concurrent respiratory infection (OR = 14.3), diarrhea (OR = 4.2), and fever (OR = 1.5) compared with nonxerophthalmic children (100). In Ghana, serum retinol concentration was significantly correlated with levels of the acute-phase response proteins α_1 -acid glycoprotein and serum amyloid A ($r = 0.35$ and 0.20 , respectively), which are reflective of febrile infection (either clinically evident or subacute) (78). These results affirm findings of previous surveys in Africa and elsewhere that have shown a positive association between the presence of morbidity and xerophthalmia or vitamin A deficiency.

However, findings from several randomized, placebo-controlled clinical trials (RCT) contrast with observational data with respect to the impact of large-dose vitamin A supplementation on incidence and duration, or prevalence, of mild to moderate diarrhea and respiratory illnesses. In a RCT of nearly 1400 children 6–47 months of age in Central Java, Indonesia, there was no effect of vitamin A on diarrhea, but a 7% (95% CI: 3–10%) increase in the incidence of cough and a 32% increase (95% CI: 5–67%) in the incidence of ALRI (cough plus rapid respiration) were reported compared with the control group. The increased risk of respiratory illness was most evident in adequately nourished children (based on height-for-age and serum retinol levels) (116).

In a RCT of 800 12–60-month-old Indian children with acute diarrhea, there was also no effect on the incidence or duration of subsequent diarrheal episodes. However, there was an 18% higher incidence and a 4% longer duration of ALRI in the vitamin A versus the control group although these differences were not statistically significant (117). A second RCT in India, of nearly 600 children below 3 years of age, reported no differences in incidence or duration of either diarrhea or ALRI. Both groups also displayed comparable ponderal and linear growth (118).

Summary

A RCT in Tanzania among 554 moderately underweight (by weight-for-age) preschool children reported that respiratory, febrile, and malarial morbidity were not markedly reduced among vitamin A recipients (119). In the Ghana VAST morbidity trial, no differences were recorded in the reported weekly incidence or duration of multiple illness symptoms, the exceptions being a ~14% decrease in rates of vomiting and food refusal in the vitamin A group (115).

One conclusion that emerged from papers presented is that while vitamin A supplementation appears to clearly reduce severity of infection and consequent mortality, supplementation may not substantively alter the risk of acquiring a diarrheal or respiratory infection (114,116–119).

Linking Vitamin A to Other Micronutrient Issues

For the first time at an IVACG meeting, leading scientists in the areas of iron (Dr. James Cook) and iodine (Dr. Rainer Gutekunst) nutrition were invited to give overviews of these two nutrients. Drs. Clive West and James Olson contributed papers relating aspects of vitamin A nutrition to iron and iodine, respectively.

IRON DEFICIENCY

Iron deficiency affects an estimated 1.3 billion people, with prevalences reaching 50% in South Asia and in Africa. Consequences of tissue iron deficiency include impaired psychomotor development and cognitive function in infants and preschool children, poor work performance in adults, and anemia in pregnant women predisposing to low birth weight, prematurity, and increased risk of perinatal mortality. Dietary iron availability depends on the total iron levels in the diet, bioavailability of nonheme iron, and the content of heme iron (i.e., from fish, chicken, or meat) in the diet, with the latter two being most important. Dietary inhibitors such as polyphenols in tea or coffee, phytates in cereals and certain protein sources, and excessive blood loss appear to increase the risk of iron deficiency. Iron status can be accurately assessed by measurements of serum transferrin receptor (tissues), serum ferritin (stores), and hemoglobin (blood),

which together permit iron deficiency anemia to be distinguished from nonnutritional anemia (resulting from malaria, HIV infection, chronic inflammation, hemoglobinopathies, etc.) (120).

The most difficult challenges to controlling iron deficiency relate to the delivery of adequate dietary iron to large vulnerable groups. Daily iron supplementation during pregnancy may be effective but, to date, has largely been unsustainable. Future efforts may focus on fortifying foods consumed by high-risk groups or adding an iron chelator, such as EDTA, to the diet. Dietary modification encompasses efforts to increase intake of heme iron and food sources of vitamin C with meals, while decreasing intakes of nonheme iron inhibitors. However, these dietary approaches are generally not economically viable and are unlikely to significantly impact on this deficiency problem in the near future (120).

Vitamin A deficiency is known to induce anemia in animals and humans (121). Studies of Indonesian pregnant women showed that serum retinol level was positively correlated with hemoglobin, hematocrit, and serum iron levels (122,123). The same association between serum retinol and hemoglobin was observed in children in the southern Shoa region of Ethiopia (124). However, in children in the Hararge region, a strong negative correlation was observed between serum retinol and serum ferritin, suggesting that the relationship between vitamin A deficiency and anemia may be explained by an inhibition of iron release from the liver (125). Studies in vitamin A-deficient rats seem to confirm this mechanism: iron accumulates in the liver but is depleted in bone marrow, where red blood cells are produced. Since circulating levels of transferrin are also low in vitamin A deficiency, iron transport from the liver to bone marrow is inhibited in vitamin A deficiency. Thus, vitamin A deficiency should be assessed where severe anemia occurs, since it may be possible to partly control anemia by preventing vitamin A deficiency (122).

IODINE DEFICIENCY DISORDERS (IDD)

Iodine deficiency leading to a group of iodine deficiency disorders, or IDD, affects more

than 200 million persons, predominantly in mountainous regions of Latin America, Asia, and Europe and in Central Africa. Iodine is essential for the synthesis of thyroid hormones that regulate neural development, growth, and organ function. Iodine deficiency during pregnancy can lead to reproductive failure and complications during pregnancy. Fetal and postnatal iodine deficiency leads to permanent neurological deficit, deaf mutism, mental retardation, and growth retardation leading to cretinism in its most severe stages. Iodine deficiency may also decrease resistance to infection and increase risk of mortality. Goiter (an enlarged thyroid) results from overcompensation of the thyroid gland caused by iodine deficiency. A large goiter may obstruct the trachea, lead to heart failure, or mask thyroid malignancy. IDD retards socioeconomic development, since affected individuals are often handicapped and less productive, and may require social and rehabilitative services (126).

Assessment of iodine deficiency in the community is based on clinical signs (thyroid gland palpation for goiter) or biochemical indicators (urinary iodine or thyroid stimulating hormone [TSH] or blood spot TSH levels), supported when possible by ultrasonography. A WHO classification system is in wide use for goiter assessment. Biochemical assays are readily available, but laboratory techniques should be standardized. Goiter and spot urine surveys are typically repeated over time to monitor the effectiveness of iodine interventions. Salt iodization, where feasible, has proven to be effective in controlling IDD in populations. Periodic iodine supplementation (orally or by injection) is also effective where salt iodization is not feasible. Possibilities exist for coordinating the periodic delivery of iodine and vitamin A supplements in populations where both deficiencies exist (126).

With respect to this last point, studies have been under way to test the stability of vitamin A (retinyl palmitate) given with iodinated poppy seed oil (Lipiodol), either as separate or combined preparations. Vitamin A appears to be stable in poppy seed oil alone (i.e., stable for >2 months at 37°C). When this preparation is mixed at a 1:1 ratio with iodinated poppy seed oil, the vitamin A remains stable for 15

days but is irreversibly changed to inactive products by 2 months. When vitamin A concentrate is added directly to Lipiodol, nearly all vitamin A activity is lost within 24 hours. Poppy seed oil may contain a protective compound for vitamin A that is destroyed on iodination. These preliminary findings suggest that it may be efficacious to coadminister vitamin A and iodinated oil supplements as separate solutions, but this requires further field testing (127).

A panel discussed how efforts might be coordinated to prevent vitamin A, iron, and iodine deficiencies. Emphasis was placed on the need for flexibility, efficiency, synergism wherever possible, and advocacy in assessing individual country needs and resources and in developing intervention strategies, as has been recently proposed (128). Mention was made of a joint micronutrient consultative team that will form in the Philippines this year to characterize deficiency overlap and identify sectoral resources that could address all three micronutrients. The aim will be to identify areas in the country where preventive action for all three micronutrient deficiencies can converge and to evaluate the "joint team" approach to solving a multiple micronutrient deficiency problem.

New Horizons in Vitamin A Research

In his invited lecture (129), Dr. Frank Chytil of Vanderbilt University summarized the most recent advances in molecular genetics and developmental biology that have begun to elucidate the mechanisms of vitamin A in regulating gene transcription. Probably largely through its intermediate metabolite, retinoic acid (RA), vitamin A is now known to affect the expression of at least 350 genes. The mechanism of action appears to resemble that of steroid hormones: retinoic acid enters the cell nucleus and interacts with RA receptors that in turn recognize specific DNA sequences that respond to RA or its isomers by either activating or suppressing gene transcription. This process is mediated by nuclear retinoic acid receptor proteins, which are members of the larger family of proteins that includes receptors for steroid and thyroid hormones as

Summary

well as vitamin D₃. Thus far, two types of retinoic acid receptors have been identified, each encoded by three genes. This area of research has recently received unprecedented attention (130). These nuclear interactions are likely responsible for the regulatory role of vitamin A in cellular differentiation and may underlie the epithelial metaplasia, keratinization, and other tissue effects observed in vitamin A deficiency.

Vitamin A, or more specifically RA, is essential for animal development, from the earliest stages of fertilization, implantation, organogenesis, and morphogenesis (e.g., limb development) through organ maturation and proper function, including that of the visual and immune systems. The effects of vitamin A (or its absence) appear to be highly sequential and time-dependent, and are tissue-specific. Thus, vitamin A depletion alters the morphology of the trachea by activating the expression of keratins, which leads to squamous metaplasia. In the testes, however, although seminiferous tubules are destroyed in deficiency, no keratinization takes place. Nuclear metabolic responses to vitamin A repletion are fast acting and observable within hours in cell cultures. Later and more frequently observed morphologic and functional changes may be consequences of these early metabolic effects. Research will continue to reveal new and exciting evidence on mechanisms of action that will advance our understanding of the roles of vitamin A in health and disease in the years ahead.

Agency Commitments for the Virtual Elimination of Vitamin A Deficiency by the Year 2000

FOOD AND AGRICULTURE ORGANIZATION (FAO) OF THE UNITED NATIONS (57)

FAO, as the lead agency in organizing the 1992 International Conference on Nutrition (ICN) in Rome, is committed to advancing food-based approaches for the sustainable prevention of vitamin A deficiency. FAO encourages national policy makers and programmers to adopt balanced and comprehensive programs that place micronutrient-rich food production and consumption first and that phase

out unrestricted large-dose vitamin A supplementation as food-based approaches take hold. FAO requests continued, vigorous support from donors for efforts to develop and carry out food-based interventions. It challenges scientists to address behavioral, food consumption, and operational research issues that can advance dietary strategies, and seeks collaboration with other UN agencies to help governments tackle food-based approaches. Finally, it is recommended that IVACG shift its focus to food production, availability and consumption, and nutrition education issues that are relevant to sustainable efforts to prevent vitamin A deficiency.

UNICEF (131)

UNICEF is firmly committed to assisting governments along with other agencies to prevent vitamin A deficiency within the broad need to control micronutrient malnutrition by the year 2000. The "triple A" approach—assessment, analysis, and action—can provide opportunities to achieve these goals. UNICEF is working with WHO and FAO to develop a mid-term plan to promote the adequacy of nutritious foods in vulnerable populations, exclusivity of breastfeeding for the first 4–6 months of life, and adequacy of health care services. Agency policies encourage both the treatment of xerophthalmia and related illnesses and the supplementation of children prophylactically for immediate control of vitamin A deficiency while correcting the underlying dietary causes through nutrition education, gardening, and fortification. Strengthening the service and delivery components of vitamin A programs is a key concern.

WORLD HEALTH ORGANIZATION (WHO)

WHO is committed to the virtual elimination of vitamin A deficiency by the Year 2000 through coordinated interagency and governmental efforts to enact practical national solutions to overcome micronutrient deficiencies. Reductions of blindness and mortality are seen as the key public health endpoints of vitamin A deficiency control. WHO recognizes the need for an appropriate mix of short- and long-term strategies to prevent micronutrient deficiencies. WHO is currently developing a Micronu-

trient Deficiency Information System that will globally monitor the extent of deficiencies and regularly update the status of country control programs (132). Within WHO, the Nutrition Unit is working with the Prevention of Blindness Programme to develop standardized assessment forms and with the Communicable Diseases Research Programme to develop dietary guidelines on feeding the sick child.

WORLD BANK (133)

The World Bank provides country loans to achieve national goals of poverty alleviation, increased food production, and human resource development. Loans carry either a nominal interest fee or a carrying charge. The World Bank increasingly views the achievement of adequate micronutrient nutrition as necessary for developing human resources. These goals are pursued by providing policy advice and analyses as well as investment loans for nutrition or nutritional components in other sectors and by working with international and national agencies. Currently, 36 countries are benefiting from World Bank loans with nutrition components in which micronutrient, and especially vitamin A, deficiency control is prominent. The number of World Bank loans with nutritional emphasis will increase dramatically over the next 6 years, reflecting the bank's commitment to investing in nutrition for development, focusing on what is feasible and cost effective.

ADMINISTRATIVE COMMITTEE ON COORDINATION—SUBCOMMITTEE ON NUTRITION (ACC/SCN) OF THE UN (134)

The United Nations has no formal nutrition agency. The ACC/SCN, with membership from the UN agencies, the UN University, and World Bank and assisted by an advocacy group of nutrition consultants, serves as the focal point for harmonizing nutrition policies and exchanging nutrition information within the UN system. The SCN regularly examines issues related to micronutrient malnutrition through its three expert groups on iodine, vitamin A, and iron. Although the SCN is currently under review, the Plan of Action of the ICN, held in Rome in December 1992, charged the SCN

with coordinating the assistance of UN agencies to governments implementing their country nutrition plans to end death by famine by the turn of the century and with controlling both micronutrient and protein-energy malnutrition.

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) (135)

The Office of Nutrition at USAID has an outstanding record in supporting vitamin A research and development over the past 20 years and remains committed to its vitamin A work. This commitment to vitamin A and other micronutrients, part of a broader set of agency goals to ensure food security and improve dietary intakes by families in developing countries, is fully congruent with the goals of the ICN. This micronutrient mandate is carried out by the Office of Nutrition, which has global responsibility for nutrition activities within USAID, with support from regional bureaus. In this role, the office coordinates agency work related to research, policy guidance, and program field support. Partners include private voluntary organizations, universities, and private contractors who work through USAID missions with host country governmental and nongovernmental counterparts. Areas of focus include biosocial and operational research, program evaluation, methods development, and status assessment, often within the context of household gardening, social marketing, food preservation and fortification, and supplementation. USAID supports information exchange and networking through funding of publications, meetings, workshops, and conferences (such as those carried out by the IVACG). USAID supports numerous projects in Asia, Latin America, and Africa, and seeks especially to expand its nutrition work in Africa.

SWEDISH INTERNATIONAL DEVELOPMENT AUTHORITY (SIDA) (136)

SIDA, an agency under the Swedish Foreign Affairs Ministry, administers nearly half of Sweden's development assistance. It has divisions of health, natural resources, NGOs, food aid, and emergency assistance and distributes funds to about 20 cooperating partners in de-

Summary

veloping countries. Research is funded by the Swedish Agency for Research Cooperation (SAREC). No specific vitamin A research projects are currently being funded, but SAREC has funded research on other micronutrients and on breastfeeding. SIDA supports institutional development in Africa—in Ethiopia, Zimbabwe, Zambia, and Tanzania—for nutrition work through financial assistance, training, and technical support. SIDA was the main funder for the first 5-year national plan for combating vitamin A deficiency in Tanzania, and is contributing to the second 5-year plan. A few years ago Sweden agreed to fortify the rape seed oil it donates as food aid with vitamin A.

Through UNICEF, SIDA has funded 33% of the national capsule distribution program in Bangladesh since 1981, and since 1989 has supported a communication and home garden project through Worldview International Foundation, together with Dutch and Norwegian donors. Funds have been provided for program monitoring and evaluation, and a small study is being planned to evaluate whether limited fat consumption may be constraining program success. Funding also was provided for the production of the video *From Darkness into Light*, and support for a longer-term program in Bangladesh is under consideration.

There is currently an increased interest in micronutrients, and support has been provided to the ACC/SCN for micronutrient work. Core support has been provided to the International Council for the Control of Iodine Deficiency Disorders (ICIDD), together with funding for operations research on the monitoring and evaluation of iodized oil capsule distribution from epidemiologic, economic, and communications perspectives.

DISCUSSION

Participants drew attention to the 1.4 billion persons who have little or no access to health care, including more than half of all people who live in Africa. The need to empower communities to deal with health care, including means to control micronutrient deficiencies, was stressed. Mention was made that most discretionary funds for addressing health and nutrition issues lie within develop-

ing-country governments and that stronger in-country advocacy of international and national agencies is needed to affect policy and funding for micronutrient deficiency control programs.

Nongovernmental Organization Commitments for the Virtual Elimination of Vitamin A Deficiency by the Year 2000

INTERNATIONAL EYE FOUNDATION (IEF) (137)

The IEF is a 31-year-old agency whose primary goal is to prevent blindness, visual impairment, and eye disease in developing countries. The IEF currently works in 11 countries, including three with vitamin A and child survival emphasis. The IEF's collaborative work with governments and other NGOs includes maternal postpartum and preschool child vitamin A supplementation, multimedia diet and health communications, breastfeeding promotion, immunization, and diarrheal disease control, nutritional assessment, and drought relief, training, and conferencing. The IEF is committed to assisting host governments to develop national coordinated strategies to control vitamin A deficiency.

SIGHT SAVERS (138)

Formerly the Royal Commonwealth Society for the Blind, Sight Savers is committed to reducing unnecessary blindness in the developing world through comprehensive eye care. Sight Savers channels its resources to high-risk communities through government and NGO partners. Vitamin A programming occurs within broader approaches to prevent blindness. Projects evolve through evaluation. In India, a large, multipartner child development project gave way to more focused health education projects carried out by community health workers and through Hindu drama. Comprehensive eye care for mothers and children in Bangladesh is being incorporated into under-5 clinics. In Africa, Sight Savers supports a regional ophthalmic medical assistant training program. Sight Savers seeks to identify 1) sustainable eye care models that work

under low resource and infrastructure situations and 2) program indicators of effectiveness and resource utilization.

EYE CARE-PROVAX (139)

The Eye Care-PROVAX project began in 1989 to enhance coverage of vitamin A capsule (VAC) distribution in Haiti. It now works with the Haitian Ministry of Health and 13 NGOs, with USAID funding, to incorporate vitamin A activities (VAC distribution, nutrition education, gardening, food preservation, social marketing) into existing elements of primary health care (the WHO Expanded Programme on Immunization [EPI], oral rehydration therapy, growth monitoring, family planning, etc). VAC coverage in the country has steadily improved, although coverage of the ~185,000 targeted children in program areas through existing services is still only 36%. PROVAX is committed to assisting the government of Haiti to bring vitamin A deficiency under control by the year 2000 through greater NGO participation and closer collaboration with the Ministry of Health, the Pan American Health Organization, UNICEF, and other agencies. A National Vitamin A Council has been established to advise on policy and program aspects of vitamin A deficiency prevention.

HELEN KELLER INTERNATIONAL (HKI) (140)

Founded in 1915, HKI has been a leader in xerophthalmia and vitamin A deficiency prevention since 1972, within the context of the agency's global blindness prevention programs. HKI works closely with governments, NGOs, universities and other national institutions, the World Bank, WHO, and UN organizations. HKI initiates programs through advocacy and the creation of linkages; refines, develops, and tests interventions; and provides technical support for programs. HKI is active in vitamin A food fortification and supplementation and in household gardening projects, all of which are supported by communications and education programs and, where possible, are linked to existing or planned programs (e.g., vitamin A supplementation within the EPI, testing com-

bined micronutrient approaches). Currently HKI has vitamin A projects in Niger, Mali, Burkina Faso, Yemen, Bangladesh, Indonesia, and the Philippines. HKI is also proactive in information dissemination and networking by organizing country and regional workshops and in international meetings such as that in Bellagio in February 1992 and the Breakout Micronutrient Deficiency Workshop at the ICN.

WELLSTART INTERNATIONAL (141)

As an agency involved in lactation management education, Wellstart International serves as a bridge between groups working to prevent vitamin A deficiency and promote breastfeeding. In the past 10 years, Wellstart has trained more than 420 health professionals from 30 countries in aspects of lactation management. These trained associates have introduced national policy, set up additional in-country training programs, and carried out clinical research with respect to breastfeeding. In recent years, Wellstart has strengthened the vitamin A link to breastfeeding in its technical assistance and teaching activities and has prepared a state-of-the-art literature review (142), including many practical guidelines, on vitamin A and breastfeeding.

TASK FORCE SIGHT AND LIFE (143)

Since 1986, SIGHT AND LIFE has supported 214 projects in 48 countries in Asia, Latin America, and Africa, with more than half in Africa. Most of these projects support scientific or community information programs. Scientific support includes supplying and monitoring the stability of vitamin A preparations for field testing through the Roche quality assurance program. Apart from the manufacturing process, Dr. Gmunder explained how heat, moisture, light, trace elements, oxygen, and deoxidizing agents affect the stability of preparations and that expiry dates fixed at production are based on assumptions about these factors. Currently, preparations are formulated to maintain at least 90% activity at the date of expiry, which can range from 2 years for vitamin A stored in blister packs at 25°C to more than 3 years for liquid preparations in screw-cap aluminum bottles stored at 30°C. SIGHT

Summary

AND LIFE also undertakes serum retinol analysis for projects, but this is done only under exceptional circumstances and when quality control procedures have been strictly followed in collecting and handling specimens. SIGHT AND LIFE is also developing capsules with twist-off nipples that would dispense with the need for snipping instruments. Furthermore, SIGHT AND LIFE has been developing education materials for professionals, mothers, and children, guided by a belief that health education, social mobilization, and community participation are powerful tools to achieve dietary change.

ASIAN VEGETABLE RESEARCH AND DEVELOPMENT CENTER (AVRDC) (62)

The AVRDC is an international center whose general goal is to advance nutritional well-being and to raise incomes in poor rural areas through the production and consumption of vegetables. There are three major programs being pursued: 1) genetic research and crop improvement (e.g., development of heat-tolerant and disease-resistant vegetables), 2) research on production systems that are sustainable and are prudent in their need of inputs, and 3) information, human resource development, and capacity building. In the AVRDC experience, a problem revealed with home gardening is that while it is very useful, the community infrastructure required to sustain it is often lacking, leading to collapse of such programs. The AVRDC is addressing these problems by focusing on ways to improve and sustain garden systems and year-round veg-

etable availability and on the training of national partners and information dissemination. Activities now extend beyond the Asian region, with pilot projects in the Sahel and a new center in Tanzania, from where the AVRDC seeks to expand its technical services and support to the East African region.

THE NUTRITION FOUNDATION, INC. (144)

The Nutrition Foundation, Inc., is a division of the International Life Sciences Institute (ILSI) and has been associated with IVACG since its inception in 1975. Serving as the IVACG Secretariat, the Nutrition Foundation is a liaison and information source for the vitamin A community. It organizes the IVACG meetings and publishes their reports and convenes and publishes findings of task forces that address key issues on vitamin A deficiency prevention. IVACG is guided by a steering committee with input from a group of dedicated regional representatives in Africa. Given the importance of multiple micronutrient deficiencies, the Nutrition Foundation has responded to a request from USAID to foster a more formal relationship among the individual micronutrient expert groups: IVACG, INACG, and ICCIDD. A process has begun to bring representatives of these groups together to identify research, policy, and program areas that overlap. The Nutrition Foundation and ILSI will work to facilitate efforts, where possible, to address joint micronutrient deficiencies in the years ahead.

CLOSING REMARKS

In a prelude to his closing remarks, Dr. Abraham Horwitz, the chairman of IVACG, suggested that the theme for the next IVACG meeting focus on the importance of dietary interventions (145).

The present meeting was seen to represent a "turning point" at which projects, with their lessons learned, are finally evolving into programs. Particular note was made of the fact that projects can excel in organization, management, and impact, whereas effective programs are not so easily achieved. Efficiency is much easier to achieve in small, well-funded projects than in large-scale programs, the latter requiring investment, trade-offs, and commitment of future resources. Dr. Horwitz emphasized that there must be a shift in emphasis from technical feasibility to sustainability as programs are developed. To attain the ICN goals, objectives must be achievable and consistent with available resources. It was noted that the donor community is receptive to requests to support programs that have clearly defined objectives and direction. Dr. Horwitz recalled the "political commitment" described in the country presentations, which appeared to be a common denominator for the most successful programs. These modest successes to date indicate that successful control of vita-

min A deficiency need not await the trickle-down benefit of general development.

Effective monitoring and evaluation systems within programs can provide the basis for assessing achievements and for shifting the focus of programs with time, for example, in deciding when and how to phase out supplementation while successfully phasing in other interventions.

The need to integrate programs was emphasized, but caution was advised not to compromise, for the sake of integration, parts of a program that are functioning successfully. For that reason, in certain circumstances highly focused interventions may still be necessary. The paucity of information on the linkage between micronutrients, in terms of both effect and programs, was noted and identified as an area for research.

Dr. Horwitz noted the exciting and highly scientific exchanges at the meeting, which was noted to be the largest and the most successful in IVACG history. In closing, he drew attention to the persisting problem of vitamin A deficiency in the world today. He termed this situation cruel because it places mothers and children at risk, immoral because it denies basic human values, and unnecessary because it can be eliminated.

.....

.....

.....

.....

.....

.....

.....

.....

.....

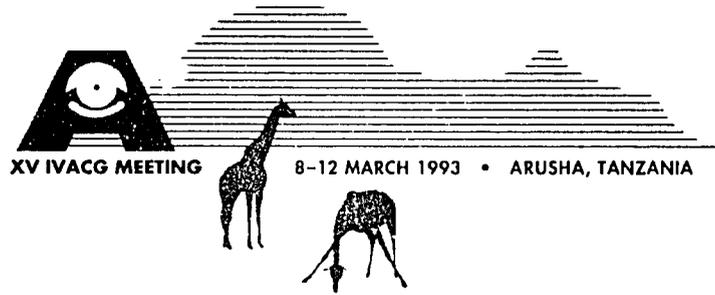
.....

.....

.....

.....

.....



References

References

Note: Names given in italics are those of people who spoke at the meeting. Most references are to papers prepared for the meeting, abstracts of which are included in this report. References in which a name is not italicized are generally to relevant published works.

1. *Kavishe FP*, Managing Director, Tanzania Food and Nutrition Centre. Opening remarks
2. *Moyo EG*, Chair, National Vitamin A Consultative Group. Opening remarks
3. *Duale EA*, World Health Organization Representative, Tanzania. Opening remarks
4. *Toole D*, UNICEF Representative, Tanzania. Opening remarks
5. *N'Dow W*, United Nations Development Programme Resident Representative, Tanzania. Opening remarks
6. *Simmersbach F*, Food and Agriculture Organization of the United Nations Representative, Rome. Opening remarks
7. *Dodge C*, UNICEF Representative, Regional Office. Opening remarks
8. *Davidson F*, Office of Nutrition, Bureau for Research and Development, U. S. Agency for International Development. Opening remarks
9. *Horwitz A*, Chair, International Vitamin A Consultative Group. Opening remarks
10. *Meghji ZH*, Deputy Minister of Health, Tanzania. Opening remarks
11. *Tematitwa CR*, Mulokozi G. An overview of the National Programme for Prevention and Control of Vitamin A Deficiency and Xerophthalmia in Tanzania
12. *Kweba MF*, Mbwaswi RO. Vitamin A capsule distribution through the PHC system: the Tanzania experience
13. *Mselle L*, Nonga D, Massawe B. Dietary approaches for the control of vitamin A deficiency in Tanzania
14. *Ndossi G*. Monitoring progress through the sentinel xerophthalmia surveillance system
15. *Missano H*. Information, education, communication and training in the vitamin A deficiency control programme in Tanzania
16. *Mmbaga BBO*. Initiation of control of vitamin A deficiency through primary health care
17. *Kihamia CM*. Public health measures in the control of vitamin A deficiency: proposal to control intestinal parasites
18. *Tematitwa CR*. A proposed plan for tea fortification with vitamin A.
19. *Kevany J, Greene J*. Vitamin A projects to programs: what does it take? an international perspective
20. *Kavishe FP*. Vitamin A projects to vitamin A programs: what does it take? an experience from Tanzania: national perspective
21. *Reddy V*. Vitamin A projects to programs: case study from India
22. *Santos L*. Vitamin A projects to programs: case study from Brazil
23. *Solon FS*. What it takes to move from vitamin A projects to vitamin A programs: case study from the Philippines
24. *Mason JB*. Programs: how do we know they are working?: international perspective
25. *Tarwotjo I*. Indonesia's experience in dealing with vitamin A deficiency problems
26. *Tarwotjo I, Fajans P, Muhilal, Grosse S, Pak S, Gorstein J, Tilden R*. Factors affecting the utilization of community based micronutrient interventions in eastern Indonesia
27. *Arhin DC, Ross D*. Vitamin A supplementation in Bolgatanga-Frafra District, Ghana: costs and the window of opportunity for integration with EPI
28. *Barrows JM, Courtright P, Chapel H*. Vitamin A supplementation in Chikwawa District, Malawi: mother's knowledge, delivery strategies, missed opportunities
29. *Hadi H, Dibley MJ, Kusnanto H*. Factors associated with coverage of vitamin A capsule distribution in a district in Central Java, Indonesia, 1991
30. *Greiner T*. Prerequisites for the initiation of "universal" VAC distribution: a policy think piece
31. *Hussey G, Klen M*. Evaluation of a policy of routine high dose vitamin A therapy for children hospitalized with measles
32. *Stoltzfus RJ, Hakimi M, Miller KW, Rasmussen KM*. Vitamin A status and lactation in Indonesian women: a randomized trial of high-dose supplementation in the post-partum period
33. *Humphrey J, Natadisastra G, Muhilal, Friedman D, Tielsch J, West K, Sommer A*. Relative protection of one oral 100,000 IU or 200,000 IU dose vitamin A against deficiency
34. *Mabika J, Mandishona EM, Mazonde S, Mukonoweshuro W, Nyazema NZ*. Vitamin A supplementation: a must during supplementary feeding in refugee camps in Zimbabwe

References

35. Pokharel GP, Curtale F, Pant CK, Muhilal, Monto A, Gorstein J, Pak-Gorstein S, Tilden R. Characteristics of non-responsive Bitot's spots in Nepal
36. Tuason CS, Klemm RDW. Integration of vitamin A capsule supplementation into Operation Timbang: a team approach (in the Philippines)
37. Islam N. Success of communication programme in reducing vitamin-A deficiency through changing dietary habit
38. Sclafani JA. Social marketing in the prevention and control of vitamin A deficiency: an unfinished agenda
39. Oswall K, Drake W, Gopaldas T, Gujral S, Abbi R, Shekar M. Integration of vitamin A supplementation and management information systems with community health and social development services: an impact evaluation in India
40. Tilden RL, Curtale F, Pokharel GP, Lepkowski J, Pant CR, Pokhrel RP, Grosse RN. Cost, coverage, and change of health status associated with alternative approaches to the control of vitamin A deficiency in Nepal
41. West KP Jr, Sommer A. Periodic large oral doses of vitamin A for the prevention of vitamin A deficiency and xerophthalmia: a summary of experiences. International Vitamin A Consultative Group (IVACG), The Nutrition Foundation, Washington, DC, 1984
42. Beaton GH, Martorell R, L'Abbe KA, Edmonston B, McCabe G, Ross AC, Harvey B. Effectiveness of vitamin A supplementation in control of young child morbidity and mortality in developing countries: summary report. University of Toronto, December 1992
43. Sommer A. Vitamin A deficiency and its consequences: field guide to their detection and control. 3rd ed. World Health Organization, Geneva, 1993
44. Cohen N. Delivering vitamin A supplements at immunization contacts
45. Underwood BA. Vitamin A deficiency in infancy
46. Sutanto A, Muharso, Hutter N. Integration of the delivery of vitamin A supplements to infants and post partum women into the routine immunization program on Lombok island, Republic of Indonesia
47. de Francisco A, Chakraborty J, Chowdhury HR, Yunus MD, Baqui AH, Siddique AK, Sach RB. Safety of vitamin A supplementation through EPI in rural Bangladesh
48. West KP Jr, Khatri SK, LeClerq SC, Adhikari R, See L, Katz J, Shrestha SR, Pradhan EK, Pokhrel RP, Sommer A. Tolerance of young infants to a single, large dose of vitamin A: a randomized community trial in Nepal. Bull WHO 1992;70:733-739
49. WHO/UNICEF/IVACG Task Force. Vitamin A supplements: a guide to their use in the treatment and prevention of vitamin A deficiency and xerophthalmia. World Health Organization, Geneva, 1988
50. Coutsoudis A, Broughton M, Coovadia HM. Vitamin A supplementation reduces measles morbidity in young African children: a randomized, placebo-controlled, double-blind trial. Am J Clin Nutr 1991;54:890-895
51. Hussey GD, Klein M. A randomized controlled trial of vitamin A in children with severe measles. N Engl J Med 1990;323:160-164
52. Barclay AJG, Foster A, Sommer A. Vitamin A supplements and mortality related to measles: a randomized clinical trial. Br Med J 1987;294:294-296
53. Rosales FJ, Chipaila P, Chama I, Mukuka G, Kjolhede C. Effect of a single oral dose of vitamin A (200,000 IU) on morbidity in acute measles cases recruited at urban clinics in Ndola, Zambia
54. West KP Jr, Katz J, Shrestha SR, LeClerq SC, Khatri SK, Pradhan EK, Pokhrel RP, Sommer A. Impact of periodic vitamin A supplementation on early infant mortality in Nepal
55. Daulaire NMP, Starbuck ES, Houston RM, Church MS, Stukel TA, Pandey MR. Childhood mortality after a high dose of vitamin A in a high risk population. Br Med J 1992;304:207-210
56. The FAO Vitamin A Programme: fourth summary progress report 1991-1992
57. Simmersbach F. Agency commitments for the virtual eradication of vitamin A deficiency by the year 2000: Food and Agriculture Organization of the United Nations
58. International Conference on Nutrition. World declaration and Plan of action for nutrition. Food and Agriculture Organization of the United Nations/World Health Organization, Rome, 1992
59. Chandrasekhar U, George B. Changes in knowledge, attitude and practices of children and mothers given supplementation and nutrition education with special reference to vitamin A
60. Devadas RP. Dietary habits and β -carotene rich food intakes of children (6-12 years of age) participating in the Dr. M. G. R. Nutritious Meal Programme

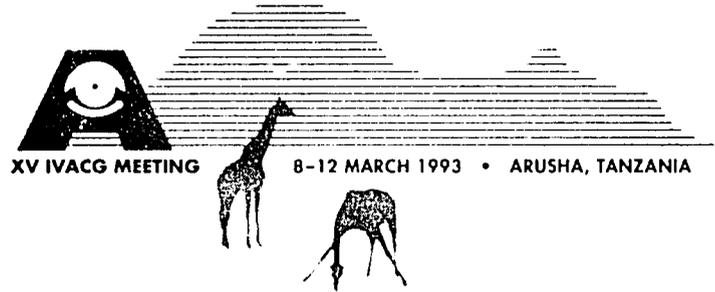
References

61. Badcock J, Giay T. FAO/Australia–Nutrition Improvement Project, Vietnam: a multisectoral, community-based approach to addressing food and nutrition problems [poster was presented by Dr. Tu Ngu]
62. *Opeña R*. Nongovernmental organization commitments for the virtual eradication of vitamin A deficiency by the year 2000: Asian Vegetable Research and Development Center
63. *Tabibul AK*, Talukder A, Hall G, Bloem MW. The impact of vegetable variety on children's vegetable consumption in Bangladesh
64. Lopez CY, Calderon O, Schwartz S, Quan J, Portocarrero L, Soto LM, Esquite A, Mendoza I, *Bulur J*, Solomons NW, Barrows J. Production, vitamin A content, and consumer acceptability of an "instantized" sweet potato product prepared in the form of a gruel beverage or puree paste: experience in Guatemala
65. *Rose ET*. Leaf concentrate food allows full ingestion for weaning age children
66. Linehan M, Paddack K, Mansour M. Solar drying for vitamin A. Vitamin A Field Support Project (VITAL), International Science and Technology Institute, Arlington, Virginia, 1993. Funded by the U. S. Agency for International Development
67. *Linehan M*. Solar drying vitamin A-rich foods
68. Rankins J, Sze C, Sathé SK, Green NR. Development of "mango perental" for the prevention of vitamin A deficiency in the Sahel
69. *Smitasiri S*. Summary of dietary behavior poster session
70. *Olson JA*. Indicators of vitamin A status: an overview
71. *Sommer A*. Issues related to clinical and histological methods of assessment for vitamin A deficiency
72. *Ross DA*, Badu JK, Amidini A, Weobong C, Awine E, Abbott RA, Filteau SM, Tomkins AM, McLaren DS, Kjolhede C. A comparison of serum retinol levels and conjunctival impression cytology results in young children in Ghana
73. *Resnikoff S*, Farbos S, Castan R, Huguet P. Relation between impression cytology test and trachoma
74. *Han Y*, Lin T. Assessment of vitamin A status in China by the modified conjunctival impression cytology (CIC) method
75. *Congdon N*, Humphrey J, Friedman D, Clement L, Natadisastra G, Sommer A, Wu L. Assessment of vitamin A status by a prototype dark adaptometer
76. *Ross D*. Issues related to biochemical methods of assessment for vitamin A deficiency
77. Oliver RWA, *Kafwembe EM*. The stability of vitamin A circulating complex in spots of dried serum samples absorbed on filter paper
78. *Filteau SM*, Morris S, Abbott KA, Tomkins AM, Kirkwood B, Arthur P, Ross D, Gyapong J, Raynes J. Serum retinol and acute phase proteins of children in northern Ghana
79. *Tanumihardjo SA*, Permaesih D, Muherdiyantiningsih, Dahro AM, Rustan E, Muhilal, Karyadi D, Olson JA. Comparisons of vitamin A assessment techniques in Indonesian children and further refinement of the modified relative dose response (MRDR)
80. Raghuramulu N, Manorama R, Visweswara R, Reddy K, Reddy V. Modified relative dose response test for the assessment of vitamin A status in children
81. Dawiesah S. *Dibley MJ*, *Tanumihardjo SA*. Vitamin A status in preschool Indonesian children as measured by the modified relative-dose response assay
82. Tilden RL, Muhilal, Tarwotjo I, *Atmarita*, Drake W, Fajans P. Can community serum vitamin A levels be used for predicting the risk of xerophthalmia?
83. *Drake WD*, Pak S, Tarwotjo I, Muhilal, Gorstein J, Tilden R. Villages in transition: elevated risk of micronutrient deficiency
84. Underwood BA, Chavez M, Hankin J, et al. Guidelines for the development of a simplified dietary assessment to identify groups at risk for inadequate intake of vitamin A. International Vitamin A Consultative Group (IVACG), The Nutrition Foundation, Washington, DC, 1989
85. Hawley G, *Linehan M*. Vitamin A deficiency in the South Pacific: Tuvalu, Vanuatu, Solomon and Cook Islands
86. *Mansour M*. Experiences in training and use of modified versions of the IVACG simplified dietary guidelines
87. *Mendoza HR*. Vitamin A deficiency in the Dominican Republic
88. *Sloan NL*, Rosen DS. Validation of the HKI food frequency method to identify communities with vitamin A deficiency
89. *Humphrey J*, Friedman D, Natadisastra G. Assessment of the dietary intake of vitamin A by preschool Indonesian children by two methods
90. *Stoltzfus RJ*, Rasmussen KM, Hakimi M. A simplified food frequency method to assess relative vitamin A intake

References

91. *de Pee S*, West CE, van Staveren WA, Muhilal, Karyadi D, Hautvast JGAJ. The vitamin A intake and serum retinol levels of lactating and non-lactating non-pregnant women in rural West Java and local food restrictions which limit their vitamin A intake
92. *Florentino R*. Summary of vitamin A deficiency survey poster session
93. *Khatry SK*, Pokhrel RP, West KP Jr, Katz J, LeClerq SC, Sommer A. Risk factors for xerophthalmia in Nepal
94. Muhilal. Changing prevalence of xerophthalmia in Indonesia, 1978-1992
95. Rankins J, Green NR, Tremper W, Stacewicz-Sapuntzakis M, Bowen P, Ndiaye M. Seasonal variation in vitamin A status in Linguere, Louga region of Senegal
96. *Morris SS*, Kirkwood BR, Arthur P, Ross DA, Gyapong JO, Tomkins AM, Abbott RA, Filteau SM. Determinants of vitamin A deficiency in northern Ghana
97. *Atina EA*, Wilson MR, Drew CR. Prevalence of xerophthalmia and risk of vitamin A deficiency among children in the extreme north province of Cameroon
98. *Julien MLR*, Canotilho L, Cogill B, Samussudine M, Mbeve A, Xerindza F, Mungwambe T. The assessment of vitamin A deficiency in three cities in Mozambique
99. *Coutsoudis A*, Mametja D, Jinnabhai CC, Coovadia HM. The implications of urbanization for vitamin A deficiency amongst children in South Africa
100. *Kawuma M*, Sserunjogi L. Consequences for human health and development of vitamin A deficiency
101. de Caballero E, *Nelson D*. The prevalence of vitamin A deficiency and iron deficiency anemia of preschool children in Panama
102. *Ninuk T*, Dibley MJ, Serdula M, Sadjimin T, Kjolhede CL. A simple method to assess vitamin A intake: experience with a food frequency questionnaire for preschool children in rural Central Java, Indonesia
103. *Sserunjogi L*. Assessment of dietary behavior related to vitamin A in Uganda
104. Paz TD, Rosen D, Sloan N, Ramos AC, Del Rosario AV. Assessment of vitamin A deficiency and strategies for its control in rural areas of Davao City, Philippines
105. Ross DA, *Dollimore N*, Binka FN, Smith PG, Addy HA. The effects of vitamin A supplementation on childhood mortality in northern Ghana
106. West KP Jr, Pokhrel RP, Katz J, LeClerq SC, Khatry SK, Shrestha SR, Pradhan EK, Tielsch JM, Pandey MR, Sommer A. Efficacy of vitamin A in reducing preschool child mortality in Nepal. *Lancet* 1991;338:67-71
107. Herrera MG, Nestel P, El Amin A, Fawzi WW, Mohamed KA, Weld L. Vitamin A supplementation and child survival. *Lancet* 1992;340:267-271
108. Vijayaraghavan K, Radhalah G, Surya Prakasam BS, Ramesjwar Sarala KW, Reddy V. Effect of massive dose vitamin A on morbidity and mortality in Indian children. *Lancet* 1990;2:1342-1345
109. Rahmathullah L, Underwood BA, Thulasiraj RD, Milton RC, Ramaswamy K, Rahmathullah R, Babu G. Reduced mortality among children in southern India receiving a small weekly dose of vitamin A. *N Engl J Med* 1990;323:929-935
110. Arthur P, Kirkwood B, Ross D, Morris S, Gyapong J, Tomkins A, Addy H. Impact of vitamin A supplementation on childhood morbidity in northern Ghana [letter]. *Lancet* 1992;339:361-362
111. *Hussey G*. The relationship between vitamin A status and severity of acute respiratory tract infections in children
112. *Mally RKF*, Roulet M. Vitamin A status among Togolese preschool children presenting with acute diarrhea
113. *Semba RD*, Graham NMH, Paleniecek J, Caiaffa WT, Scott AL, Clement L, Saah A, Vlahov D. Increased mortality associated with vitamin A deficiency during HIV infection
114. *Barreto ML*, Santos LMP, Assis AMO, Araujo MPN, Farenzena GJ, Fiaconne RL. Effect of vitamin A supplementation on childhood morbidity in Northeast Brazil
115. *Arthur P*, Kirkwood BR, Ross DA, Morris SS, Gyapong JO, Tomkins AM, Addy HA. Vitamin A supplementation reduces severity of childhood illnesses in Ghana
116. *Dibley MJ*, Sadjimin T, Kjolhede CL. Impact of high dose vitamin A supplementation on incidence and duration of episodes of diarrhea and acute respiratory infections in preschool Indonesian children
117. Bhan MK, Bhandari N, Sazawal S. Effect of massive dose vitamin A administered during acute diarrhea on subsequent diarrheal and respiratory morbidity
118. *Ramakrishnan U*, Latham MC, Abel R. Effect of vitamin A supplementation on growth and morbidity of preschool children in a growth monitoring research project in southern India

119. *Ndossi GD*, Latham MC, Roe DA, Miller DD, Stephenson LS. Impact of vitamin A supplementation in preschool children in Iringa, Tanzania
120. *Cook JD*. Nutritional iron deficiency
121. Hodges RE, Sauberlich HE, Canham JE, Wallace DL, Rucker RB, Mejia LA, Mohanram M. Hematopoietic studies in vitamin A deficiency. *Am J Clin Nutr* 1978;31:876-885
122. *West CE*, Suharno D, Muhilal, Karyadi D, Wolde-Gabriel Z, Roodenburg AJC, Beynen AC, Hautvast JGAJ. Role of vitamin A in nutritional anemia: recent studies in pregnant women in Indonesia, children in Ethiopia, and in laboratory animals
123. Suharno D, West CE, Muhilal, Logman MMHG, de Waart FG, Karyadi D, Hautvast JGAJ. Cross-sectional study on the iron and vitamin A status of pregnant women in west Java, Indonesia. *Am J Clin Nutr* 1992;56:988-993
124. Wolde-Gabriel Z, West CE, Gebru H, Tadesse AS, Fisseha T, Gabre P, Ayana G, Hautvast JGAJ. Interrelationship between vitamin A, iodine and iron status in school children in Shoa region, central Ethiopia. *Br J Nutr* (in press 1993)
125. Wolde-Gabriel Z, Gebru H, Fisseha T, West CE. Vitamin A, iron and iodine status in children with severe vitamin A deficiency in a rural village in the Hararge region of Ethiopia. *Eur J Clin Nutr* (in press 1992)
126. *Gutckunst R*. Iodine deficiency disorders (IDD) and their elimination
127. *Olson JA*, Gunning DB, Cohen N. Effects of an oral iodine preparation on the stability of retinyl palmitate
128. Trowbridge FL, Harris SS, Cook J, Dunn JT, Florentino RF, Kodyat BA, Venkatesh Mannar MG, Reddy V, Tontisirin K, Underwood BA, Yip R. Coordinated strategies for controlling micronutrient malnutrition: a technical workshop. *J Nutr* 1993;123:775-787
129. *Chytil F*. New horizons in vitamin A research
130. *Pfahl M*. Molecular mechanisms of action for vitamin A derived hormones
131. *Aburick D*. Agency commitments for the virtual eradication of vitamin A deficiency by the year 2000: UNICEF
132. Clugston G, Gorstein J, Pak S, *Underwood BA*. Present status of the WHO Micronutrient Deficiency Information System: vitamin A
133. *Green J*. Agency commitments for the virtual eradication of vitamin A deficiency by the year 2000: World Bank
134. Mason JB, *Horwitz A*. Agency commitments for the virtual eradication of vitamin A deficiency by the year 2000: Administrative Committee on Coordination—Subcommittee on Nutrition (ACC/SCN)
135. *Davidson FR*. Agency commitments for the virtual eradication of vitamin A deficiency by the year 2000: U. S. Agency for International Development (USAID)
136. *Greiner T*. Agency commitments for the virtual eradication of vitamin A deficiency by the year 2000: Swedish International Development Authority (SIDA)
137. *Barrows J*. International Eye Foundation: commitment for the virtual eradication of vitamin A deficiency by the year 2000
138. *Dixon P*. Nongovernmental organization commitments for the virtual eradication of vitamin A deficiency by the year 2000: Sight Savers
139. *Fleury A*. Nongovernmental organization commitments for the virtual eradication of vitamin A deficiency by the year 2000: Eye Care—PROVAX
140. *Palmer J, Sclafani J*. Nongovernmental organization commitments for the virtual eradication of vitamin A deficiency by the year 2000: Helen Keller International
141. *Newman V*, Naylor A, Schooley J. Prevention of vitamin A deficiency through breastfeeding promotion: the role of Wellstart International
142. Newman V. Vitamin A and breastfeeding: A comparison of data from developed and developing countries. Wellstart International, San Diego, 1993
143. *Gmünder J*. Nongovernmental organization commitments for the virtual eradication of vitamin A deficiency by the year 2000: Task Force SIGHT AND LIFE
144. *Aomari LL*, Harris S. Nutrition Foundation report to XV IVACG Meeting
145. *Horwitz A*. Closing remarks for XV IVACG Meeting



Abstracts

These abstracts were transcribed to facilitate the presentation of this report. The secretariat regrets any typographical or other errors that may have been introduced as a result of this transcription. The text of the abstracts remains as submitted by the authors. Presenters' names are italicized. Abstracts appear in the order given in the program (pp. 5–23) herein.

AN OVERVIEW OF THE NATIONAL PROGRAMME FOR PREVENTION AND CONTROL OF VITAMIN A DEFICIENCY AND XEROPHTHALMIA IN TANZANIA

*C.R. Temalilwa, Msc.**, *G. Mulokozi, Msc.**

In Tanzania vitamin A deficiency is a problem of public health significance ranking fourth to PEU, nutritional anaemia and iodine deficiency disorders (IDD), in that ascending order. The problem affects approximately 6.0% of the population and preschool children are the most affected, followed by pregnant and lactating women.

The immediate causative factors include inadequate dietary intake of foods rich in vitamin A, fat and protein; diseases (measles, RTI, diarrhoea, malaria, etc.) limiting intake absorption and utilization. Underlying causes include household food insecurity, inadequate care of children and women, and inadequate basic services (water, health, education, sanitation, housing and clothing, etc.). The basic causes are unfavourable economic situation, limited resources and negative socio-cultural practices influencing life-styles.

The national programme for prevention and control of vitamin A deficiency is now in its second phase of implementation (1990/91–1994/95.) The programme, which addresses the major causative factors, has two major components, namely, interventions and supportive elements. The interventions include supplementation, dietary approaches and fortification limited to urban and sub-urban areas. Supportive elements include research, information education and communication, laboratory services, monitoring and evaluation, and programme management and coordination.

The overview looks at the major achievements made, contributing factors, and future plans aimed at strengthening ongoing interventions and supportive elements.

*Tanzania Food and Nutrition Centre

VITAMIN A CAPSULE DISTRIBUTION THROUGH THE PHC SYSTEM: THE TANZANIA EXPERIENCE

M.F. Kweba*, R.O. Mbwasi**

Disease-targeted vitamin A capsule distribution started in 1987 when the Ministry of Health, acting on advice from the Tanzania Food and Nutrition Centre started including high-dose vitamin A capsules in the essential drugs "kits". Adoption of the disease-targeted capsule distribution, instead of other methods like universal distribution, was prompted by the fact that already there existed a good and extensive PHC infrastructure with programmes such as Maternal and Child Health (MCH), Expanded Programme on Immunization (EPI), Essential Drugs Programme (EDP), Health Education and Family Planning.

The choice of the EDP, therefore, was seen as a better way of reaching the targeted population and achieving a good supplementation coverage, because it already had a reliable drug supply and trained health workers. Knowledge, attitudes and practice of health workers form a very important link in achieving a good coverage. Rapid surveys done by TFNC and monthly returns for drug stocks from the rural health facilities showed significant piling-up of the supplied capsules. This was later attributed to the fact that the health workers had little or no knowledge in the identification of the clinical signs of vitamin A

deficiency and also the safe use of high-dose vitamin A preparations. Training workshops on the subject matter have been conducted by TFNC in all districts of mainland Tanzania, and there are already indications that the pile-up is being reduced. A study to assess the attitudes and practice of health workers towards supplementation will be done this year.

Coordinated efforts are going to involve the community in identification of children at high risk of developing xerophthalmia and sending them to the health facilities for treatment.

The existence of a National Drugs Policy which, among other things, gives direction on all matters pertaining to drugs, is perhaps the foundation on which the supplementation programme lies.

With the good foundation and wide coverage of PHC units, coupled with the regular supplies of vitamin A capsules, coverage of supplementation is expected to increase as more of the targeted groups turn up for treatment at health facilities.

*Programme Officer, Tanzania Food and Nutrition Centre

**Chief Pharmacist & EDP Manager, Ministry of Health

DIETARY APPROACHES FOR THE CONTROL OF VITAMIN A DEFICIENCY IN TANZANIA

L. Mselle*, D. Nonga**, and B. Massawe†

Dietary approach is one of the strategies employed in Tanzania for prevention and control of vitamin A deficiency. Dietary approaches include breastfeeding, improvement of weaning foods and child feeding practices, promotion of production and consumption of red palm oil, and home gardening activities.

The home gardening project aims at ensuring adequate availability and consumption of fruits and vegetables for the target group all year round. The basis for initiating this project emanated from the fact that fruits and vegetables are scarce during dry season, especially in semi-arid areas like Singida. If production of vitamin A rich fruits and green leafy vegetables could be promoted and their preservation improved, then it could control the problem of vitamin A deficiency in Singida. The initiation started by organising a multi-

sectoral national committee which led the community to discuss their problems and came up with intervention strategies suitable for their environment.

Main strategy employed in Singida is support to community efforts. This was afforded by distributing fruit seedlings (papaya and guava) to the household through primary school pupils. Amaranth seed was also distributed to the households and solar drying technology has been introduced. In future it is planned to support the households with groundnut seed and strengthen ongoing village water projects.

*Tanzania Food and Nutrition Centre

**Singida District Agricultural Office

†Singida Regional Agricultural Office

INFORMATION, EDUCATION, COMMUNICATION AND TRAINING IN THE VITAMIN A DEFICIENCY CONTROL PROGRAMME IN TANZANIA

*H. Missano**

Information, Education, Communication and Training (IECT) in a nutrition programme is aimed at affecting change in knowledge, attitudes and behaviour and in improving skills of targeted audience in dealing with nutrition problems. It also builds up capabilities and capacities of institutions in dealing with the problems. In Tanzania IECT activities in nutrition are being conducted by many organizations, both government and non-governmental. The main ones being Ministries of Agriculture Livestock Development and Co-operatives, Health, Community Development, Women's Affairs and Children and Education, others include Tanzania Food and Nutrition Centre and the Tanzania Episcopal Conference which is a non-governmental organization. IECT conducted by these institutions uses a number of techniques which include radio, press, printed materials, social mobilization and campaigns. In training formalized certified courses and non-certified short courses are given at different levels. Training seminars are also given to mass media personnel so that they are able to collect nutrition information and produce articles for their respective media. Reviewing of curricula is being conducted

to ensure consistence in the content of nutrition education given and to introduce new concepts.

IECT in the vitamin A deficiency control programme for a long time has been conducted as part of the general nutrition education package. However, of recently efforts have been made to strengthen the component by developing materials and conducting trainings specifically for the control of vitamin A deficiency.

Despite the fact that there are many institutions involved in IECT and that a number of activities are undertaken by each, the IECT's contribution has not had an impact. Although people have gained in knowledge, this has not led to change in behaviour. Lack of change could be due to the limitations within the programme. Some of the identified limitations of the present IECT packages in control of vitamin A deficiency include lack of well established needs assessment procedures, inadequate sectoral collaboration, poor communication infrastructure, inadequate capabilities and capacities, and lack of monitoring and evaluation plans.

**Tanzania Food and Nutrition Centre*

INITIATION OF CONTROL OF VITAMIN A DEFICIENCY THROUGH PRIMARY HEALTH CARE

*Dr. B.B.O. Mmbaga**

Vitamin A is among known micronutrients that are essential for normal health and survival. Through Primary Health Care is the only way to reach the need and assist the community towards comprehensive programmes to reduce vitamin A deficiency. However, we ought to collaborate with other sectors like Agriculture, Veterinary, Education, Water, etc.

Towards the objectives of this paper short and long term strategies have been elaborated very well. Committed and dedicated person-

nel are needed to reach the target. Reduction of this problem will require our effort on education follow-up, evaluation and feedback to the community we are working with. Demonstration of DGLV e.g. garden drying methods, storage, etc., are required. Proper use of DGLV especially to children who are in great demand is crucial.

**Dodoma Regional Hospital*

PUBLIC HEALTH MEASURES IN THE CONTROL OF VITAMIN A DEFICIENCY: A PROPOSAL TO CONTROL INTESTINAL PARASITES

Prof. C.V. Kihamia*

Intestinal helminths and schistosomiasis are highly prevalent in Tanzania, and worm loads are particularly common in preschool and school-age children. These parasites are among the top ten health problems of Tanzania, and are responsible for causing a lot of morbidity and appreciable mortality. It is known that these worms directly cause disease, but they are also responsible for contributing to protein energy malnutrition, growth retardation, stunting, anaemia and poor school achievement. Part of the scientific research that proves the association of intestinal worms, especially *Ascaris lumbricoides*, has been done here in Tanzania. Recently, intestinal helminths have been shown to contribute to development of vitamin A deficiency.

In the past, the control of intestinal helminths and schistosomiasis has depended on health education, provision of water supplies and sanitation improvement. Much emphasis has been laid on sanitation and water and a number of projects have been carried out in different ways and by many agencies in many localities of the country. However, the experience so far shows that there has been virtually

no impact of these efforts on the prevalence of intestinal parasites and schistosomiasis.

Recently, the availability of two very effective drugs against intestinal worms and schistosomiasis have revolutionized our strategy for the control of these parasites. The drug albendazole is a broad-spectrum, single dose anthelmintic proved to be suitable for mass administration. Another drug, praziquantel, is particularly effective against all forms of schistosomiasis—this drug has also been found to be very useful in mass treatment. So, with the availability of these potent drugs, Tanzania has decided to embark on a programme of de-worming which, due to the nature of the parasite problem, is going to have the following three components: anthelmintic administration, micronutrient supplementation, especially vitamin A, and participatory health education. The first effort by TFNC has been planned for Lindi district and we look forward to seeing the results of this initiative.

*Muhimbili Medical Centre, Dar es Salaam, Tanzania

A PROPOSED PLAN FOR TEA FORTIFICATION WITH VITAMIN A

C.R. Temalilwa, Msc.*

For quite some time, Tanzania has implemented two interventions, namely supplementation with vitamin A capsules and dietary approaches by promotion of breastfeeding and production and consumption of foods rich in vitamin A, fats, and protein.

In order to accelerate achievement of the national nutrition goal of eliminating vitamin A deficiency by the year 2000, the country has opted to introduce a nationwide fortification programme. Foods considered for fortification are tea leaves, vegetable oil, and sugar. Initially, efforts will be concentrated on fortification of tea leaves.

This paper focuses on a plan for introducing fortified tea leaves to the market. It covers feasibility studies, pilot intervention, and strategies to introduce fortified tea to the market. The various proposed research activities are to be conducted by TFNC, in collaboration with industry and a number of international organisations, and funding is to be provided by UNICEF and the Tanzania Government through IDA.

*Director, Laboratory Services Dept., Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania

PROJECTS TO PROGRAMS: WHAT DOES IT TAKE? NATIONAL PERSPECTIVE: BRAZIL*L.M.P. Santos**

There is general agreement that the first and fundamental step to turn from Projects to Programs is political decision. Now the question that is posed is the following: what does it take to have a political decision made? In our country's perspective, epidemiological evidence of vitamin A deficiency was the triggering factor. A national dietary survey (7 day weighing) was conducted in 1974-75. The results, partially published only in 1982, showed highly insufficient vitamin A intakes in the Northeast region. In rural areas 70% of families did not meet 50% of the recommended daily requirements. During 1975-85 a series of prevalence surveys of serum and liver retinol (necropsy specimens) in the Northeast showed low levels in four states. In the period of 1981-85 a state-wide survey in Paraiba found not only mild signs of conjunctival xerophthalmia but also severe cases of corneal xerophthalmia and blindness in very young children. As a result, the National Institute of Nutrition (INAN) of the Ministry of Health, started in 1983 the Hypovitaminosis A Control Program in the state of Paraiba. Later it was extended to the other eight states of the Northeast, under the agreement of the State's Secretariats of Health. In some cases the initiative was of the Municipal Secretariats of Health, like in Caruaru, where an independent program was going on. The INAN program delivers vitamin

A to children 1-6 years old, integrated with the National Immunization Program. The latter operates with routine EPI (20,000 sites) but also organizes National Immunization Days twice a year, when 300,000 to 500,000 immunization sites are set up and children 0 to 6 receive polio, DPT, measles and in some regions hepatitis B, yellow fever vaccines and vitamin A in the states that agreed to. In the ten years of the Program, Paraiba is the only state fully covered. The program has some advantages, like being integrated to a successful ongoing health program, thus operating at a very low cost and being very well-received by the population. The major constraints are institutional discontinuities among the government agencies, complaints from the vaccination staff about the extra burden, the use of capsules until 1991 (time-consuming), and problems with the importation of vitamin A. The Hypovitaminosis A Program in Brazil is not well-consolidated yet as a long-term strategy. As far as future perspectives, there are plans to start in the very near future a program with the rural extension services aiming at increasing the production and consumption of vitamin A rich foods.

*Escola de Nutricao, Universidade Federal Bahia, R. Araujo Pinho 32, Salvador, Ba, 40140, Brazil

WHAT DOES IT TAKE TO MOVE FROM VITAMIN A PROJECTS TO VITAMIN A STATUS

F.S. Solon, M.D., M.P.H.*

In the Philippine experience, the important factors that move vitamin A projects to vitamin A programs are the following: 1) *Mandate*. The National Nutrition Council, recognizing vitamin A deficiency as a public health problem, mandates government and non-government organizations to address the problem in their plans and programs. This political will has hastened the transformation of vitamin A projects to program status in the various sectoral nutrition plans. 2) *Relevance and quality results*. Well-designed projects addressing service gaps with quality methods and impact became the basis for designing strategies for nationwide application. Examples are assessment and vitamin A capsule supplementation projects now adopted by the public health service of the Department of Health. 3) *Collaboration and location*. Projects jointly designed/implemented by non-government (NGOs), government (GOs), and private voluntary organizations (PVOs), strategically located in the government's nutrition unit with actively participating managers and field personnel, became the core component of the sector's nutrition plan. Examples are education, training, community-based planning and

management projects done in collaboration with the Nutrition Unit of the Department of Health were utilized in the formulation of the five year comprehensive nutrition program. 4) *Partnership*. Strong partnership between NGO and industry through sharing of financial, technical and operational resources contributes to the sustainability of nationwide programs. One example is the TV and radio social marketing project of NGO, industry, and the broadcaster's association. 5) *Funding*. Adequate funding from external and local sources providing continuing support helped in propelling the project to program status. Examples are the NGO and PVO education projects for vitamin A that have been adapted as part of national programs. 6) *Advocacy*. Project proponents who strongly promoted the adoption of project components in the medium-term program plan of various GOs and NGOs succeeded in having these project components integrated in the medium-term plan.

*Nutrition Center of the Philippines, P.O. Box No. 1858, Makati, Metro Manila, Philippines

PROGRAMS: HOW DO WE KNOW THEY ARE WORKING? NATIONAL PERSPECTIVE: INDONESIA'S EXPERIENCE IN DEALING WITH VITAMIN A DEFICIENCY PROBLEMS

*I. Tarwotjo**

Like most developing countries, Indonesia has four major nutrition problems: Protein Energy Malnutrition, Iodine Deficiency Disorders, Vitamin A Deficiency, and Nutritional Anemia. The presentation focuses on Vitamin A Deficiency problems.

Sound planning for appropriate strategy and intervention program cannot be made until the true magnitude and nature of the problem is identified.

A number of approaches have been used in Indonesia to the understanding of what, where, who, how, and why about the occurrence of vitamin A deficiency problems. These include analysis of reports from various clinics and scattered studies, cross-sectional community survey, epidemiological studies, prospective and retrospective, community control trials, and in-depth clinical investigation.

The findings of such studies are presented to government officials at national and local levels to gain political commitment and supports. To convince the decision-makers that the problem can be solved, initial plans of feasible effective intervention are proposed.

Examples of actual experience in Indonesia are presented to the audience, from the initial stage in the development of the intervention program of high-dose vitamin A capsule distribution, to the latest phase of the more comprehensive program mix.

Report of findings from the recent xerophthalmia survey in 1992 is also quoted, for general comment and discussion.

*Ministry of Health, Jl. Hang Jebat IV No. 2, Rt. 004/004, Kebayoran Baru, Jakarta Selatan 12120, Indonesia

COST, COVERAGE AND CHANGE OF HEALTH STATUS ASSOCIATED WITH ALTERNATIVE APPROACHES TO THE CONTROL OF VITAMIN A DEFICIENCY IN NEPAL

R.L. Tilden*, F. Curtale*, G.P. Pokharel*, J. Lepkowski**, C.R. Pant*, R.P. Pokhrel*, R.N. Grosse†

Three alternative approaches to the control of vitamin A deficiency were evaluated for 24 months in the terai and mid-hill areas of Nepal. The cost of the field programs, the rates of participation for different activities within the alternative control programs, and changes of the health status that could be attributed to the program were generated. Approaches to control vitamin A deficiency included 1) a mega-dose capsule distribution program, 2) selective primary health care activities to reduce impact of diseases commonly associated with xerophthalmia, and 3) a nutrition education program to modify the dietary habits of mothers. 54,000 children aged 6 months to 120 months were examined at baseline for X, measured and weighed. At the 12-month and the 24-month follow-up exams, program participation information was collected. The programs were well-accepted by the rural communities with coverage exceeding 80% for the capsule program and de-worming program. The costs of all programs were relatively low, and it appears that the district health offices and health posts in the study area have the capacity to deliver and maintain any of the programs. There was a great deal of variation among the different cohorts in terms of cost, coverage, and level of health impact produced by the activities. The capsule distribution program was the cheapest alternative. It was effective in reducing overall risk for xerophthalmia. Low level of maternal literacy resulted in the development of non-literate community education materials and health care worker training materials. A maternal literacy program was initiated in some of the nutrition education areas. However, the children of

mothers who understood the messages of the nutrition education program had the largest overall improvement of health (risk of xerophthalmia and improvement in nutritional status) associated with participation in the project activities. Primary health care activities were associated with reduction of risk for corneal xerophthalmia, but were less effective in reducing risk of Bitot's spots and poor nutrition. Risk of mortality was reduced by participation in all of the interventions. While the activities did reduce the risk of children that participated in the programs, villages at high risk at baseline continue to be at high risk at the 12- and 24-month exam, regardless of which intervention activity took place. Community level risk was defined by agricultural patterns, maternal literacy rates, and household sanitation levels. Xerophthalmia is a significant health problem in Nepal, causing death, blindness, and poor nutritional status among its children. The risk of this problem can be reduced at low cost by the implementation of nutrition education programs and capsule distribution programs. However, long-term control can only be achieved by improving maternal literacy, improvement of agricultural practices that lead to increased availability of calories within the community and family, as well as improving the household sanitary living conditions.

*Nepal Vitamin A Child Survival Project, Kathmandu, Nepal

**Institute of Social Research, University of Michigan, Ann Arbor

†Department of Population Planning and International Health, School of Public Health, Ann Arbor, Michigan

SUCCESS OF COMMUNICATION PROGRAMME IN REDUCING VITAMIN A DEFICIENCY THROUGH CHANGING DIETARY HABIT,

*N. Islam**

This presentation contains the Programme Initiative taken up by Worldview-Nutritional Blindness Prevention Programme (NBPP). The programme was initiated in 1984 as a pilot project in a northern sub-district of Pirgonj, in Rangpur district, to combat nutritional blindness caused by vitamin A deficiency among the age group of 0-9 years, by means of some very popular motivational communication media approaches like school media, folk singer media, radio and television spots, documentary film show, cinema spot, billboard, pictorial print material, government and NGO workers media. World-view adopted these media so as to reach its programme messages to the target people effectively and thus implement its objectives.

The main objectives of the programme were to: a) raise awareness of the village people about the causes of night blindness and their prevention through intaking vitamin A-rich vegetables and fruits, b) increase production of carotene-rich foods and c) increase dark green leafy vegetables (DGLV) consumption by the mothers and children; all of these in turn would change their traditional dietary habit and reduce the prevalence of night blindness.

At the 2nd and 3rd year of this Pilot Project evaluations were done to assess the further need of the programme. It was revealed in the evaluations that the target people had developed awareness of the causes of night blindness, and for their prevention they had turned to consume green leafy vegetables—a sign of change in dietary practice. The evaluations also strongly recommended further expansion of the programme with some new approaches.

So NBPP was then expanded in the 2nd phase in 21 sub-districts of Rangpur and Dinajpur districts in 1987 for 3 more years, with some specific objectives viz. a) to reduce night blindness by 1% from the base 5.92 to 4.92, b) to raise awareness about the causes of night blindness from the base 18 to 80%, and

c) to educate them to grow vitamin A-rich vegetables from the base 10 to 60%, and non-citrus yellow fruits from the base 7 to 40%. This time a new approach, women volunteers (WVs), was adopted, instead of government and NGO workers. The WVs were recruited from the respective project areas so that they could work freely, with easy access to mothers and children.

During this phase of the project, further evaluations were conducted which prescribed the project to be introduced in wider range than before, because some stunning achievements were found from the project areas. For example, a) the rate of night blindness was reduced by 1.05% as against 1% (i.e., more than 100%), b) the awareness about night blindness was increased by 94% as against 80%, and c) the education to grow vitamin A-rich vegetables was increased by 71% as against 60%, and vitamin A-rich non-citrus fruits increased by 44.6% as against 40%. Specific emphasis on sustainability of the programme was recommended.

This growing demand of the programme led Worldview to introduce a regular project of 3 years in its 3rd phase in 1990, covering 4 million population in 21 sub-districts in Dinajpur, Lalmonirhat, and Gaibandha districts, with giving stress on sustainability of the programme. Again another new approach was taken up, forming mothers' groups from the vulnerable section of the community.

The view of this approach was to train the members of the mothers' groups on the causes and prevention of night blindness, and encourage them in carrying out home gardening activities and the messages of night blindness to their local communities, and these members would continue their activities independently, i.e., without any more support from NBPP when the programme would phase out. This approach is believed to be an effective one, because by home gardening the practice of growing more green vegetables rich in vita-

min A will be increased, resulting in positive decrease in night blindness in the proposed areas. Thus, the practice of vegetable intake will remain within the area even after the phase-out of NBPP, and this will be an example of the need of communication media in

the field of behavioral change of any community.

*Country Director, WORLDVIEW-Bangladesh, House No. 76A, Road No. 12A, Dhanmondi Residential Area, Dhaka-1209, Bangladesh

SOCIAL MARKETING IN THE PREVENTION AND CONTROL OF VITAMIN A DEFICIENCY: AN UNFINISHED AGENDA

*J.A. Sclafani**, B. Bochnovic*, K. Laursen*, C. Stengel*

Social marketing's potential usefulness to the promotion of preventive health behaviors is recognized and accepted. At its best, a marketing strategy ties together its constituent activities—audience segmentation, product development, promotion, price, and distribution, to name only five—into a single, mutually reinforcing whole, each contributing to a common objective. In its absence, such synergism is impossible, and individual elements can work at cross purposes, jeopardizing the social exchange process itself.

In practice, it has been the promotional element of the marketing model which has received the most attention. This emphasis on mass media distorts the application of a marketing model to public health interventions, and limits its ability to respond to the main challenges confronting the further development of vitamin A programs: reaching the unreached, sustained dietary change, and mes-

sage evolution from blindness prevention to child survival.

Social marketing has been a key intervention in HKI-supported programs to reduce vitamin A deficiency over the past 15 years. This experience is reviewed in several countries—primarily Bangladesh, Indonesia, Philippines—in relation to a fully-developed marketing model. Shortfalls in program performance are tied to inadequate attention to the relative “mix” of marketing activities, particularly in the critical areas of media channel-behavior fit, segmentation of program beneficiaries, and community effects as an intervening variable. Based on these lessons learned, an operations research agenda for addressing these program deficiencies will be proposed.

*Helen Keller International

EVALUATION OF A POLICY OF ROUTINE HIGH DOSE VITAMIN A THERAPY FOR CHILDREN HOSPITALISED WITH MEASLES

G. Hussey*, M. Klein*

Measles is without specific therapy and remains important globally as a cause of childhood death. Controlled studies have shown high-dose vitamin A therapy (Hi-VAT)—with 400,000 IU vitamin A—to markedly reduce measles-associated morbidity and mortality, but the extent to which these findings in research settings are applicable to the case management of measles under conditions of routine hospital practice is unknown, and it was the purpose of this study to elucidate this.

We performed a retrospective study of the hospital records of 1720 children < 15 years of age who were hospitalized for measles, and compared the outcomes during two non-consecutive 2-year periods (1985–86; 1989–90). A policy of Hi-VAT for all children hospitalized with measles had been commenced during the intervening period.

As compared with the group of children on standard therapy ($n = 1061$), children receiving Hi-VAT ($n = 651$) had a shorter hospital

stay (mean 10 vs 13 days; $P < 0.001$), a lower requirement for intensive care (4.3% vs 10.5%; $P < 0.001$), and a lower death rate (1.6% vs 5%; $P < 0.001$). In addition, vitamin A therapy (cost per patient: \$0.33) resulted in an estimated saving, for hospitalization alone, of \$200.00 per case. If the 64% reduction in mortality were included in the cost-benefit analysis, the benefits would be much greater. No adverse effects of high-dose vitamin A therapy were observed.

We conclude that a policy of high-dose oral vitamin A (400,000 IU) supplementation in measles provides benefits which are equivalent to those previously observed only in controlled research trials, that it is highly cost-effective, and that it should form part of the routine case management of all children hospitalized with measles.

*Department of Paediatrics and Child Health, University of Cape Town, South Africa

VITAMIN A SUPPLEMENTATION IN BOLGATANGA-FRAFRA DISTRICT GHANA: COSTS AND THE WINDOW OF OPPORTUNITY FOR INTEGRATION WITH EPI

D.C. Arhin*, D. Ross*, K. Adogbola**, F. Kufour**

Health service information intended for the planning and/or monitoring of district health programmes should be up to date, precise, and obtained using available resources judiciously. Employing a "rapid assessment type" design this study quickly and inexpensively investigated the cost implications of integrating vitamin A supplementation with immunization. It also assessed its potential for achieving adequate supplementation coverage. The study was conducted in the Bolgatanga-Frafra District of northern Ghana in 1990.

The average health service cost per child for full immunization plus vitamin A supplementation was \$6.47. The additional cost of providing vitamin A to a fully-immunized child

in Bolgatanga-Frafra District, using a mobile clinic approach that provided integrated curative and preventive maternal and child health care, including immunization, was \$0.02. There was no additional monetary cost to the patient, and an average additional indirect cost to the patient of two minutes waiting time. The study concluded that the pattern of utilization of immunization services in the district presented an opportunity for achieving significant vitamin A supplementation coverage.

*London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT

**Ministry of Health Ghana, P.O. Box 544 Accra, Ghana

VITAMIN A SUPPLEMENTATION IN CHIKWAWA DISTRICT, MALAWI: MOTHER'S KNOWLEDGE, DELIVERY STRATEGIES, MISSED OPPORTUNITIES

*J. Barrows**, *P. Courtright**, *H. Chapel**

The International Eye Foundation (IEF) conducted a population-based survey of mothers ($n = 2,178$) to measure baseline knowledge of child survival methods, including vitamin A, prior to initiating a large scale community-based child survival and vitamin A program in Chikwawa District of the Lower Shire Valley. Of the 3,556 children < 6 years of age included in the survey, only 494 (14%) had documented vitamin A capsule (VAC) supplementation in the past 6 months. VAC supplementation was found to be greatest among children 12-23 months of age (18%), and dropped to 6% among children 60-71 months of age. Most children 12-23 months of age (91%) attended an Under-Five clinic within the past 6 months, and of these, only 19% received vitamin A. After age 3, less than half of the children attended an Under-Five clinic. Among all age groups, "missed opportunities" for receiving vitamin A ranged from 73%-82%. Of the total mothers interviewed, 74% claimed they recognized the VAC. However, of these mothers, only 22% identified the correct role that VAC supple-

mentation plays in health. Although literate mothers and older mothers were more likely to identify the correct role of VAC supplementation in health, children of these mothers were not more likely to have received VAC supplementation, nor were they more likely to have received VAC after delivery than mothers who do not recognize the importance of supplementation. A program that relies on EPI and Under-Five clinics alone will miss over half of the children over 3 years of age regardless of mothers' knowledge of the protective role of VAC supplementation. This suggests that even if improvements are made to more completely integrate VAC supplementation into the existing EPI and Under-Five clinic network, alternative strategies may be required. Implications of these results on the development of education interventions, missed opportunities, and alternate delivery strategies will be discussed.

*IEF/USA, IEF Malawi & ICEH/UK, MOH/Chikwawa District

Abstracts

VITAMIN A STATUS AND LACTATION IN INDONESIAN WOMEN: A RANDOMIZED TRIAL OF HIGH-DOSE SUPPLEMENTATION IN THE POST-PARTUM PERIOD

R.J. Stoltzfus*, M. Hakimi*, K.W. Miller*, K.M. Rasmussen*

To evaluate the effects of high-dose vitamin A (VA) supplementation of lactating mothers, we conducted a randomized, double-blind trial in which 153 rural Javanese mothers 1-3 weeks post-partum received 312 μmol (300,000 IU) VA or placebo (PL). Mothers' serum retinol levels in the VA group were lower than the PL group at baseline, but higher at 3 months (1.38 vs. 1.23 $\mu\text{mol/L}$, $p = 0.03$), and 6 months post-partum (1.22 vs. 1.08 $\mu\text{mol/L}$, $p < 0.01$). A parallel decrease in serum retinol values was observed in both treatment groups. The milk retinol levels of the VA group were higher than the PL group by 0.35 to 1.0 $\mu\text{mol/L}$, at 1-8 months post-partum ($p < 0.05$). Among 6-month-old infants, serum retinol values < 0.52 $\mu\text{mol/L}$ were more than twice as prevalent in the PL than the VA group (36% vs. 15%, respectively, $p < 0.05$). Similarly, 23% of infants in the PL group were VA deficient by the RDR method, compared to 10% of the VA group ($p < 0.03$). Multivariate linear regression was used to model the determinants of mothers' serum

and milk retinol values. Treatment group, hemoglobin level, and weight were positively associated with serum retinol, and the effect of treatment was greater in women of lower weight. Treatment group, milk fat, serum retinol, and body mass index (BMI) were positively associated with milk retinol, and treatment effect decreased as BMI increased. Hemoglobin level and parity were negatively associated with milk retinol. In this population with marginal VA status, a single high-dose of VA given to the lactating mother improved the VA status of the mother through 8 months post-partum, and reduced the odds of VA deficiency in her 6-month-old infant by two-thirds. Women who were thinner and of higher parity had lower VA status, and thinner women benefitted more from VA supplementation.

*Div. Nutr. Sci., Cornell University, Ithaca, NY, USA; Clinical Epidemiology Unit, Gadjah Mada University, Yogyakarta, Indonesia

FACTORS AFFECTING THE UTILIZATION OF COMMUNITY BASED MICRONUTRIENT INTERVENTIONS IN EASTERN INDONESIA

I. Tarwotjo*, P. Fajans**', Muhilal'', S. Pak***', J. Gorstein***', R. Tilden**

Indonesian government health activities addressing the problem of micronutrient deficiencies at the community level are implemented as part of a monthly package of preventive and promotive health services known as the posyandu. These activities include VAC and iron tablet distribution, and promotion of DGLV consumption. Other services at the posyandu include growth monitoring, immunization, prenatal care, ORS distribution, and other nutrition and health education. Successful coverage of target populations by micronutrient interventions is often limited by the low levels of attendance at posyandu by mothers and their children.

This paper utilizes data from a micronutrient deficiency prevalence survey conducted in the eastern provinces of Indonesia to examine factors at the child, household, and community levels related to women and children's attendance at posyandu. The relationship between attendance and local health service resources and other factors related to posyandu program management were also investigated.

The frequency of attendance was not related to children's age, sex, or anthropometric status; but was related to mothers' levels of education, household economic status, and

the distance of the household from the post. The level of activity and involvement of village women's groups was strongly related to attendance levels, with other community characteristics showing weaker relationships. Health center staffing patterns, transportation resources for posyandu supervision, and other variables related to the frequency of supervision were also related to community levels of attendance. The types of services provided at the post were important, with the presence of VAC and iron tablet distribution, supplementary feeding, and the availability of pre-natal care and family planning at the posyandu all strongly related to attendance by women and children. The implications of these findings for achieving high levels of service utilization in integrated micronutrient deficiency/PPHC programs are discussed.

*Nutrition Directorate, Ministry of Health, Republic of Indonesia, Jakarta, Indonesia

**Community Systems Foundation, Ann Arbor, Michigan

‡Department of International Health, School of Public Health, University of Michigan

‡‡Center for Research and Development in Nutrition, Bogor, Indonesia

Abstracts

FACTORS ASSOCIATED WITH COVERAGE OF VITAMIN A CAPSULE DISTRIBUTION IN A DISTRICT IN CENTRAL JAVA, INDONESIA, 1991

H. Hadi*, M.J. Dibley**, H. Kusnanto*

Vitamin A capsules are distributed twice yearly by the Indonesian Ministry of Health (MOH) to children aged 1 to 5 years. Previous surveys reported low coverage of about 25% in contrast to the high coverage of about 80% reported by MOH surveillance system. We conducted a cross-sectional survey in a district of Central Java to measure vitamin A capsule distribution and factors associated with adequate dosage. The study was restricted to children aged 18 to 59 months who should have received vitamin A in February and August 1991. We used 2 stage cluster sampling initially choosing 100 village neighborhoods and then selecting seven children in each cluster. A complete course of two vitamin A capsules was received by 57.7% (95% CI: 51.2%–63.8%) of the children. However, 24.9% received only one dose during the year and 17.5% (95% CI 12.5%–22.3%) received no doses. Based on the results of a stratified analysis, we found significantly elevated prevalence odds ratios

for complete dosage if the mother had appropriate knowledge about xerophthalmia (OR 2.49, 95% CI 1.81–3.38), the benefits of vitamin A capsules (OR 3.15, 95% CI 2.29–4.28), and perception about susceptibility for xerophthalmia (OR 3.59, 95% CI 2.36–5.35). Provider factors were also strongly associated with receipt of vitamin A capsules, especially whether or not the health volunteer gave health education to the mothers during the 6 months before distribution (OR 23.29, 95% CI 15.88–39.49). We conclude that although coverage appears to have improved there remains a need to educate mothers about the benefits of vitamin A and to train cadres to provide health education to parents prior to distribution.

*Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia

**Division of Human Nutrition, Johns Hopkins University, Baltimore, MD 21205 USA

THE EFFECTS OF VITAMIN A SUPPLEMENTATION ON CHILDHOOD MORTALITY IN NORTHERN GHANA

D.A. Ross^{***}, N. Dollimore^{***}, F.N. Binka^{*†}, P.G. Smith^{**}, H.A. Addy^{††}

The Ghana Vitamin A Supplementation Trials (VAST) Survival Study was a randomised, double-blind, placebo-controlled trial of the effects of vitamin A supplementation on child mortality. 22,721 children aged 6 to 95 months were randomised in 185 geographical clusters to receive either a vitamin A or placebo preparation every 4 months. The children were followed up over a 2-year period, with continuous enrollment of new children, and data collection was completed in December 1991. 21,906 of the children received at least one dose of either vitamin A or placebo, and so entered the trial. Dosing compliance was equally high in the vitamin A and placebo clusters, with an average of 89.5% of the eligible children dosed every four months.

The mean mortality rate in vitamin A clusters, weighted by length of follow-up, was 24.0 per 1000 child-years, 19% lower than the rate in the placebo clusters of 29.5 per 1000. The weighted rate ratio in vitamin A compared to

placebo clusters was 0.82 (95% CI 0.69–0.97, $p = 0.02$). A protective effect of vitamin A was present in five of the seven age groups examined, but there was no consistent trend in the size of the effect by age. The 95% confidence intervals for all age groups included the point estimate of 0.82.

The results of more detailed analyses will be presented at the meeting. This will include analysis of the effects of vitamin A supplementation by cause, sex, season, and nutritional status, and the impact of vitamin A supplementation on vitamin A status.

*Ghana Vitamin A Supplementation Trials (VAST), Box 114, Navrongo, Ghana

**Tropical Health Epidemiology Unit, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK

†Ministry of Health, Ghana

††School of Medical Sciences, University of Science and Technology, Kumasi, Ghana

IMPACT OF PERIODIC VITAMIN A SUPPLEMENTATION ON EARLY INFANT MORTALITY IN NEPAL

K.P. West, Jr.*, J. Katz*, S.R. Shrestha**, S.C. LeClerq*, S.K. Khatri**, E.K. Pradhan*, R.P. Pokhrel**, A. Sommer*

A randomized, double-masked community trial in Nepal evaluated the impact of vitamin A supplementation under 6 months of age on reducing early infant mortality. Infants were continuously enrolled, dosed, and followed every 4 months over a 2-year period. Neonates (< 1 month of age) received either 50,000 IU or 250 IU, and infants 1-5 months received either 100,000 IU or 500 IU of vitamin A according to ward allocation. Infants were excluded from the study at the first dosing round at which they were 6 months of age or older. 11,918 infants ($n = 5832$ control, $n = 6086$ vitamin A) were enrolled, contributing 5213 child-years ($n = 2517$ control, $n = 2626$ vitamin A) of follow-up observation. Baseline characteristics were comparable between groups.

There were 130 deaths in the control and 150 deaths in the vitamin A groups for mortality rate of 51.6 and 57.1 per 1000 child-years, respectively, and a relative risk (RR) = 1.11 (95% CI: 0.86-1.42, adjusted for a 1.22 design effect). Among neonates, the RR was 1.07 (95% CI: 0.66-1.72); for infants 1-5 months of age the RR was 1.12 (95% CI: 0.83-1.52). Large-dose vitamin A supplementation in the first 6 months of life exerted no significant overall effect on all-cause, 4-month mortality.

*Dana Center for Preventive Ophthalmology, The Johns Hopkins Schools of Medicine and Public Health, Baltimore, MD, 21205, USA

**National Society for the Prevention of Blindness, Kathmandu, Nepal

EFFECTIVENESS OF VITAMIN A SUPPLEMENTATION IN CONTROL OF YOUNG CHILD MORBIDITY AND MORTALITY IN DEVELOPING COUNTRIES

G.H. Beaton*, R. Martorell*, K.A. L'Abbé*, B. Edmonston*, G. McCabe*, A.C. Ross*, B. Harvey*

Results of the 10 mortality trials that have been completed were reviewed. Using eight of these, meta-analyses were undertaken (complete data for the Bombay and Haiti studies were not available). Reported effects ranged from a 50% reduction in under-5-year mortality rates (Tamil Nadu), to no effect (Sudan). Meta-analyses provided a summary estimate = 23% reduction. 95% confidence limits were established under two models: Fixed Effect model $RR = 0.77$ $CI = 0.71-0.84$; Random Effects model $R = 0.77$ $CI = 0.68-0.88$. There are many reasons to accept that the true effect varies among projects. Using meta-analysis approaches, the relative effect of vitamin A was not dependent on either age (after 6 months) or gender. However, it did differ with attributed cause of mortality—a strong effect was demonstrable for diarrhoeal disease; an effect was detectable for measles (but n was very small); no effect could be established for respiratory disease. Using regression techniques, variation among projects could not be explained by baseline prevalences of xerophthalmia, stunting, wasting or their interactions. Control group mortality rates (a proxy for baseline mortality) did not predict the relative effect of vitamin A. Given unexplained varia-

tion among projects, prediction intervals were developed for the effect to be expected in a new program conducted in a generally similar (poverty, high prevalence of stunting, evidence of at least a low prevalence of xerophthalmia) population. The predicted *true* effect in such a population would be $RR = 0.77$ $CI = 0.60-0.99$. The predicted *observed* effect has wider bounds since sampling error must also be considered. Absolute effects on mortality are dependant on baseline mortality rates, and hence differ with age, gender, or any other characteristics that provide differentials in baseline mortality rates. Extrapolations relevant to planning will be discussed.

Results from 19 studies contributing information on morbidity effects were examined. The evidence available did not support an expectation of any important effect of vitamin A on general morbidity incidence or prevalence. However, there is suggestion, consistent with the mortality results, that severe morbidity may be favourably influenced by vitamin A status.

*International Nutrition Program, University of Toronto, Canada

VITAMIN A SUPPLEMENTATION REDUCES SEVERITY OF CHILDHOOD ILLNESSES IN GHANA

P. Arthur^{*,**†}, *B.R. Kirkwood*^{*,**}, *D.A. Ross*^{*,**}, *S.S. Morris*^{*,**}, *J.O. Gyapong*^{*,**}, *A.M. Tomkins*^{††}, *H.A. Addy*[‡]

Although huge reductions in childhood mortality have been reported following administration of vitamin A supplements to children, no reductions in morbidity have been observed, and the mechanism through which the reduction in mortality is mediated remains unknown. We conducted a randomised double-blind placebo-controlled field trial to evaluate the impact of four-monthly doses of vitamin A on the incidence, duration, and severity of childhood illnesses, specifically, diarrhoea and acute respiratory infections. 1455 children 6–59 months were individually randomised to receive vitamin A or placebo and followed for a total of 61,602 child-weeks over a full calendar year. Detailed compound level and individual child data, including clinical and laboratory assessment of vitamin A status, were collected at baseline. Follow-up data were collected using a combination of weekly and monthly visits by trained field workers, and ill children were referred to local clinics organised by the trial for a detailed assessment of illness severity. Severely ill children were admitted to hospital and monitored daily. Clinical and laboratory assessments of vitamin A status were carried out every 4 months, at which children were given their vitamin A or placebo dose. 72% of the study children were moderately or severely deficient with serum retinol levels below 0.70 nmol/L. This proportion was slightly higher in the vitamin A group than for the placebo group. The two groups were similar in all but two out of over 100 demographic, socio-economic, environ-

mental, health and nutritional variables at baseline.

There were no significant differences in incidence or mean duration of episodes between the two treatment groups for any of the symptoms or illnesses enquired for at the weekly visits, except for vomiting and refusal of food which were 13% and 15% reduced, respectively, in the vitamin A group. A comparison of severity of illness episodes, however, showed a significant reduction of illness severity in children receiving vitamin A, as seen by a lower stool frequency and occurrence of dehydration during diarrhoea, lower prevalence of respiratory noise, high temperature, and associated vomiting and refusal of feeds. Clinic attendances and hospital admissions were reduced by 12% and 38%, respectively, in the vitamin A group, who also had a significantly lower proportion of multiple attendances. The overall result is compatible with findings from earlier studies that found no impact on prevalence of illnesses, and also with the previously-observed impact on childhood mortality.

*Ghana Vitamin A Supplementation Trials (VAST), Navrongo Health Research Centre, Ghana

**Maternal and Child Epidemiology Unit, London School of Hygiene and Tropical Medicine, UK

†Ministry of Health, Ghana

††Centre for International Child Health, Institute of Child Health, London, UK

‡Department of Community Medicine, School of Medical Sciences, University of Science and Technology, Ghana

EFFECT OF VITAMIN A SUPPLEMENTATION ON CHILDHOOD MORBIDITY IN NORTHEAST BRAZIL

M.L. Barreto*, L.M.P. Santos*, A.M.O. Assis*, M.P.N. Araujo*, G.J. Farenzena*, P.A.B. Santos*, R.L. Fianconne*

A randomized (individual level), triple-blind, placebo-control community trial was completed to evaluate the impact of vitamin A supplementation on childhood morbidity. A fixed cohort of children aged 6 to 48 months received vitamin A (100,000 IU below 12 months and 200,000 IU for 12 months and above) or placebo every 4 months for a period of one year. The study was located in the town of Serrinha-Bahia, where a survey completed before the main study showed, in pre-school children, vitamin A deficiency by biochemical and dietary indicators, but no cases of xerophthalmia. A sample of 1240 children was followed thrice a week by trained field workers, when data about occurrence and severity of diarrhoea and respiratory infection was collected. If three or more liquid or semi-liquid motions were reported in a 24-hr. period, a more complete investigation about diarrhoea was done, directed to register other severity indicators. In any case of reported cough, the respiratory frequency was measured; if 40 per minute or greater, or if chest in-drawing or nasal flaring were observed, the child was visited by the pediatrician. He investigated more deeply the episode, making X-ray when indicated. At the baseline, and every 4 months thereafter, weight and length for every child was collected. Several demographic, socio-economic, environmental and health indica-

tors were similar at baseline in supplemented and placebo groups. No cases of xerophthalmia were observed at baseline or during the follow-up. Regarding diarrhoea, the mean prevalence, estimated according to different cut-off points (3 or +, 4 or +, 5 or + and 6 or +) showed vitamin A/placebo ratios of .92 ($p = .074$), .90 ($p = .049$), .80 ($p = .005$), and .77 ($p = .006$), respectively. Using the caretakers' definition the ratio was .89 ($p = .012$). Regarding the global incidence of diarrhoea episodes, the vitamin A/placebo rate-ratio was .94 ($p = .90-.98$). In episodes with 1-2 days duration it was .97 ($p = .91-1.03$), and in episodes with 3 or more days it was .90 ($p = .85-.97$). In those episodes with three or more days of duration and the mean of liquid/semi-liquid motions greater than 5, the rate-ratio was .80 ($p = .65-.98$). Occurrence of blood and mucous in the stool during the episodes were similar in both groups. Vomit (4 or + epis.) and medical care were less frequent in the vitamin A supplemented group, although the differences were not significant. Regarding ALRI and growth, the analysis done so far does not show significant differences between both groups.

*Dept. de Medicina Preventiva & Dept. de Ciencias da Nutricao, Universidade Federal da Bahia, Rua Padre Feijó, 29, 4 andar, Canela, 40.110-170 Salvador, Bahia, Brazil

IMPACT OF HIGH DOSE VITAMIN A SUPPLEMENTATION ON INCIDENCE AND DURATION OF EPISODES OF DIARRHEA AND ACUTE RESPIRATORY INFECTIONS IN PRESCHOOL INDONESIAN CHILDREN

M.J. Dibley*, T. Sadjimin**, C.L. Kjolhede*

Field-based epidemiological studies of the impact of vitamin A supplementation on the risk of diarrheal and respiratory morbidities have produced divergent results. To overcome design weaknesses with earlier studies, we conducted a double-masked, placebo-controlled community-based clinical trial of vitamin A in a rural area of Indonesia. Children in the study population, aged 6 to 47 months at the start of each of six cycles, were invited to enroll in the trial. Randomization was by individual. Half the children received four monthly doses of 60,000 μg vitamin A (30,000 μg for children aged less than 12 months) and 46 μg vitamin E, and the other half the same oily base with no vitamin A or E in identical capsules. A total of 1394 children were allocated a treatment, and an average of 799 followed in each cycle. Diarrhea and respiratory symptoms were monitored by every-other-day home visits. Children with cough had their respiratory rate measured. Field nurses re-examined children who experienced morbid events. Morbidity data for 500,000 child-days of observation were collected. Based on standard international definitions, the daily symptoms were converted by a computer algorithm to illness episodes. There were no significant differences in the incidence (RR 1.06 95% CI 0.96–1.19), nor in the duration of diarrhea episodes be-

tween treatment groups. The incidence of cough episodes (ARI) was slightly higher in each cycle in the vitamin A versus the placebo group (RR 1.07 95% CI 1.03–1.10). Acute lower respiratory tract infections (ALRI) were defined as cough episodes with at least one report of an elevated respiratory rate of > 50 /minute for children < 12 months, or > 40 /minute for children > 12 months. The incidence of ALRI was significantly higher in the vitamin A versus placebo group (RR 1.32 95% CI 1.05–1.67). Treatment with vitamin A produced a greater effect on the incidence of ARI in those children who had a serum retinol at baseline $> 0.70 \mu\text{mol/L}$ (RR 1.26 95% CI 1.09–1.45) versus those with a serum retinol $\leq 0.70 \mu\text{mol/L}$ (RR 1.04 0.94–1.16). In this population of pre-school children treatment with high-dose vitamin A had little effect on diarrhea but increased the risk of ARI and ALRI, especially in children with adequate vitamin A status. These findings suggest that the currently recommended dose and frequency of vitamin A for children needs review and further examination.

*Division of Human Nutrition, Johns Hopkins University, Baltimore, MD 21205, USA

**Clinical Epidemiology & Biostatistics Unit, University of Gadjah Mada, Yogyakarta, Indonesia

VITAMIN A DEFICIENCY IN INFANCY

*B. A. Underwood, Ph.D.**

Infants who are never breastfed, or are weaned early, can become blind as early as 2 to 3 months of age. Death usually follows when such an event occurs in poor households. Therefore, available data are inadequate from which to estimate the true magnitude of vitamin A-related blindness in infancy and its contribution to infant mortality. When blindness occurs under more favourable socio-economic circumstances, the blind infant may survive to experience a lifetime of irreversible darkness. Recent data are available from northeast Brazil, southern Thailand, and southern India that document blindness in infancy among non-breastfed and early-weaned infants. In Thailand, feeding an unfortified, prestigious sweetened condensed milk affordable by mothers who had entered the work-force, and consequently did not breastfeed, was the cause of more than 35 cases, half of which occurred by 6 months of age. In India, early weaning to inappropriate diets accounted for 17 cases of keratomalacia in 1991, and 11 cases in 1992, that were brought to the Aravind Children's Hospital. In Brazil, the cases were associated with no breastfeeding or early weaning to unfortified milk diets. Efforts are needed to determine the extent of this problem, particularly as urbanization and other factors continue to erode the prevalence of breastfeeding.

Breastfeeding is protective against clinically evident deficiency and should be encouraged as long as possible. Between 6–12 months of lactation, however, breast milk alone coming from malnourished mothers may not contain sufficient vitamin A to sustain a positive body balance. Infants are at increased risk of infection-related mortality from at least 6 months of age through the preschool years. Thus, although blinding malnutrition from VAD most often occurs in weaned children 1–3 years of age, other physiological functions for which vitamin A is critical may be impaired earlier in VAD. Empirical calculations suggest that breast milk that contains about 1.05 $\mu\text{mol/L}$ (30 $\mu\text{g/dL}$) vitamin A is sufficient to sustain a positive vitamin A balance only for 6 months or slightly beyond, and milk of lower concentrations provides an insufficient supply before 6 months.

Maintaining an adequate vitamin A nutritional status throughout infancy will prevent blindness from occurring among non-breastfed infants and those weaned early. It is likely to lessen the vitamin A-related risk of mortality and compromised health in the latter half of infancy in areas where vitamin A deficiency is endemic. Several strategies for improving vitamin A status in infancy will be discussed.

*Nutrition Unit, WHO Geneva

SAFETY OF VITAMIN A SUPPLEMENTATION THROUGH EPI IN RURAL BANGLADESH

A. de Francisco*, J. Chakraborty*, H.R. Chowdhury*, M.D. Yunus*, A.H. Baqui*, A.K. Siddique*, R.B. Sack*

A double blind, randomised, placebo-controlled trial was conducted in Matlab, rural Bangladesh, to evaluate the safety of administering 50,000 IU of vitamin A through the EPI structure.

In total, 191 infants were vaccinated with DPT and given three doses of either placebo or vitamin A at the mean ages of 6.5, 11.2 and 15.8 weeks. A comprehensive physical examination was performed to all infants on days 1, 2, 3, and 8 after supplementation by trained medical officers blind to the supplementation code. Information on feeding practices, diarrhoea, fever, cough and rash was collected.

Eleven infants presented bulging of the fontanelle in the vitamin A group and one in the placebo group (11.5 vs 1.1%, $p < 0.01$). Sixteen

out of 292 vitamin A doses (5.5%) and one out of 293 placebo doses (0.3%) were accompanied with bulging of the fontanelle ($p < 0.001$). Bulging of the fontanelle subsided spontaneously in most of the cases within 24 and 48 hours after supplementation, but lasted between 48 and 72 hours in two cases. There were no differences in temperature, cardiac and respiratory rates, breastfeeding pattern, irritability, diarrhoea, vomiting, fever, cough, or wheezing between the groups. No deaths were recorded.

*International Centre for Diarrhoeal Disease Research, Bangladesh, GPO Box 128, Dhaka 1000, Bangladesh

DELIVERING VITAMIN A SUPPLEMENTS AT IMMUNIZATION CONTACTS

N. Cohen*

Vitamin A supplements given to preschool-age children in vitamin A deficient areas have been shown to lower both morbidity and overall mortality. In some studies, the impact of supplementation has been greatest in infants aged 6–11 months. On the other hand, current periodic large dose supplementation programmes have been focused usually on children over the age of one year.

Linking supplement delivery to immunization contacts has the advantage of targeting infants specifically as well as reaching mothers within a few weeks after delivery, takes advantage of the logistics system developed for vaccines, and is likely to be sustainable. The cost-effectiveness of this method of supplement delivery is high, since immunization programmes should have contact with children at least five times during the first year of life. There is thus the opportunity for repeated relatively low dose supplementation and build up of liver reserves, with the additional advantage of booster contacts in later years. Alternative schedules for vitamin A supplementation of both infants and mothers will be discussed.

Supplementation should always be linked

to ongoing intervention programmes as appropriate for each country. Therefore, the choice of supplement delivery at immunization contacts will depend on national priorities. Factors that should be taken into consideration, and will be discussed, include the development and coverage of the immunization programme, the identification of high-risk areas to achieve accurate targeting, and the likely impact of other vitamin A deficiency control measures within the next few years. Experience will be presented from countries which have recently introduced vitamin A delivery at immunization contacts. Still, programme planners should realize that supplementation at immunization contacts cannot protect children through all the vulnerable early childhood years. Furthermore, difficult-to-reach populations where immunization coverage is lowest are most at-risk of the sequelae of vitamin A deficiency. Planning should include operational links to other health and development programmes that will provide the goal of a sustained, adequate vitamin A status for all.

*Expanded Programme on Immunization, World Health Organization, 1211 Geneva 27, Switzerland

PREREQUISITES FOR THE INITIATION OF "UNIVERSAL" VAC DISTRIBUTION: A POLICY THINK PIECE

T. Greiner*

The short-term universal vitamin A capsule (VAC) distribution program in Bangladesh celebrates its twentieth anniversary now. The 1989 evaluation of the program found its coverage to have declined to 35% of children 6 months-6 years old, compared to the 1982 coverage of 46%. In 1989, 25% of infants under 6 months old (who were not supposed to receive VAC) had, in fact, been given a 200,000 IU dose in the previous round.

Is such a program short-term, universal, or anything to celebrate? Its greatest danger is that it pacifies government and donor alike into putting off finding better solutions more likely to reach the poor and vulnerable groups: "After all, we can put off the more difficult approaches as long as we have the capsule program to fall back on." Yet, with the increased publicity vitamin A is receiving for its apparent mortality-reducing potential, there is every risk that governments and donors will rush into starting "short-term" universal VAC distribution which in effect becomes "unethical" to ever stop.

This is not to deny that vitamin A is needed, that public awareness in many countries may demand that interventions be rapidly mobilized, even if imperfect, and that some way is needed to take advantage of the positive elements of such programs while minimizing the negative ones.

This paper proposes that governments and donors adopt a policy whereby universal VAC distribution is initiated *where needed* if, and only if, certain criteria are met:

1. A political commitment is made that universal VAC distribution is indeed to be a short-term measure.

2. A budget is established for pursuing a long-term (i.e., permanent, affordable, sustainable) approach which is at least as large as the one allocated for VAC distribution.

3. A surveillance system is set up to monitor the vitamin A status of the target population *and* the diet of the vulnerable groups (probably a simplified method can be developed based on frequency of use of a select number of high-carotene foods in sentinel population groups).

4. A technically determined, but politically agreed-upon, cut-off point must be established for dietary improvement, above which universal VAC distribution is no longer to continue.

5. When the surveillance system shows that a given area shows dietary improvement above the threshold, an intensified vitamin A status surveillance system is put in place and one round of VAC distribution is skipped.

6. If the surveillance system reveals dangerous increases in vitamin A deficiency, VAC distribution is resumed and the threshold reset to a higher level.

*International Child Health Unit, Uppsala University, 75185 Uppsala, Sweden

INDICATORS OF VITAMIN A STATUS: AN OVERVIEW

J.A. Olson*

Dietary intake, metabolism, function, and the expression of clinical signs of nutritional imbalance are all linked. Thus, a variety of dietary, biochemical, histological, physiological, and clinical indicators have been used to assess vitamin A status.

Vitamin A status can be divided into five categories: deficient, marginal, satisfactory, excessive, and toxic. Although excessive and toxic (hypervitaminotic) states are often found in industrialized countries, deficient and marginal states in less-industrialized countries are a primary public health concern. A deficient state is primarily characterized by clinical eye signs (xerophthalmia), although the skin and other organs are also affected. In contrast, a marginal state doesn't show such signs, although the vitamin A reserve is inadequate. Much attention has recently focused on the marginal state, which has been associated with increased mortality in preschool children.

Of various indicators, isotope dilution procedures, which employ deuterium-labeled vitamin A, can assess the total body pool of vitamin A. Conventional clinical, biochemical,

and dietary methods are of most use in assessing the state of deficiency. In recent surveys, vitamin A response assays, such as the relative dose response (RDR) and modified relative dose response (MRDR) test, conjunctival impression cytology (CIC), and vision restoration time (VRT), have been effectively used.

Most indicators are applicable only to a specific range of the overall vitamin A status, and the useful ranges for different indicators need not be coincident. The prevalence found to induce public health concern has been suggested for many indicators, but not for all. Indeed, use of only a few indicators have thus far been approved by the World Health Organization. In a public health policy framework, therefore, the utility of various indicators, and particularly of the new ones, should now be carefully addressed.

Supported by NIH—HD-27994 and the Thrasher Research Fund—2808-2.

*Biochemistry & Biophysics, Iowa State University, Ames, IA 60011, USA

IRON DEFICIENCY: THE GLOBAL PERSPECTIVE

J.D. Cook*

The prevalence of iron deficiency anemia in industrialized countries has declined in recent decades, but there has been little change in the worldwide prevalence. Iron deficiency anemia is currently estimated to affect more than 500 million people. Recent studies have indicated that anemia *per se*, the most common manifestation of iron deficiency, is less important from a public health standpoint than liabilities associated with tissue iron deficiency. The most important of these are impairment in psychomotor development and cognitive function in infants and pre-schoolers, a deficit in work performance in adults, and an increase in the frequency of low birth weight, prematurity, and perinatal mortality in pregnancy. There have been several recent advances in combating nutritional iron deficiency. One of the major problems has been in distinguishing iron deficiency from other causes of anemia seen epidemiologically, such as malaria, HIV infection, chronic inflammation, hemoglobinopathies, and protein-calorie malnutrition. When combined with serum ferritin and hemoglobin determinations, the serum transferrin receptor assay is a valuable addition in epidemiologic surveys, because it provides a quantitative measure of functional iron deficiency, and it distinguishes true iron deficiency anemia from the anemia of chronic disease. The most difficult challenge is in developing effective methods of supplying iron to large segments

of a population. Supplementation with iron tablets is suitable for only brief periods of need, such as during pregnancy. The poor compliance with existing supplementation programs is believed to be due mainly to the gastrointestinal side-effects of oral iron, which can be eliminated by the use of an oral iron preparation which delays the release of iron while retaining it in the stomach. The most effective long-term strategy is to increase the intake of bioavailable iron in the diet. The customary approach has been to fortify a food staple such as wheat, rice, sugar, or salt, thereby increase the iron intake of the entire population. However, because of a reluctance to supply iron to segments of the population who do not require it, a more attractive strategy would be to fortify food items that are targeted directly to segments of the population at greatest risk of iron deficiency, such as children, adolescents, and women of child-bearing age. Because of the strong inhibitory properties of diets in regions of the world where iron deficiency is most prevalent, the addition of an iron chelator such as EDTA with or without added iron is a very attractive approach to reducing the global prevalence of nutritional iron deficiency.

*Division of Hematology, Department of Medicine, University of Kansas Medical Center, Kansas City, Kansas, USA

EFFECTS OF AN ORAL IODINE PREPARATION ON THE STABILITY OF RETINYL PALMITATE

J.A. Olson*, D.B. Gunning*, N. Cohen**

Nutritional inadequacies of vitamin A and of iodine are common public health problems in less-industrialized countries. If single oral supplements containing both nutrients were stable, or if separate preparations could be simultaneously administered, a single intervention program for both nutrients would be feasible. Although iodine is chemically stable, vitamin A can be converted by iodine both to isomers with lower biological activity, and to inactive iodinated products. To determine the feasibility of using single or separate preparations simultaneously, pure retinyl palmitate (RP) was dissolved in a poppyseed oil-based concentrated iodine preparation (Lipiodol-40%-G481.10, Guerbet Laboratories). Although stable in poppyseed oil alone, RP in Lipiodol was irreversibly converted to inactive products in 1 day at 21°C, and was 95% destroyed

by 21 days. RP destruction was inhibited initially, but not ultimately prevented, by first dissolving RP in poppyseed oil alone, and then mixing it with Lipiodol. When RP in poppyseed oil was mixed 1:1 with Lipiodol and incubated at 37°C in the dark, however, vitamin A was stable (> 95%) for at least 24 hours. Thus, the simultaneous administration of separate preparations of the two nutrients, but not the use of a single preparation containing both nutrients, seems feasible in public health programs.

Supported by EPI, WHO, Geneva.

*Biochemistry & Biophysics, Iowa State University, Ames, IA, USA

**Expanded Program on Immunization, World Health Organization, Geneva, Switzerland

ROLE OF VITAMIN A IN NUTRITIONAL ANAEMIA: RECENT STUDIES IN PREGNANT WOMEN IN INDONESIA, CHILDREN IN ETHIOPIA, AND IN LABORATORY ANIMALS

C.E. West*, D. Suharno***, Muhilal**, D. Karyadi**, Z. Wolde-Gebriel', A.J.C. Roodenburg*††, A.C. Bynen*††, J.G.A.J. Hautvast*

Evidence that vitamin A can contribute to nutritional anaemia comes from studies in both man and laboratory animals. We have recently carried out a series of studies aimed at evaluating the role of vitamin A deficiency in anaemia in humans, and at examining the mechanisms involved in studies using rats.

In Indonesia, a cross-sectional study of the prevalence of iron and vitamin A deficiency was carried out involving 333 clinically normal pregnant women aged 20–35 years in the second and third trimester of pregnancy from the Bogor District, West Java. According to WHO criteria, 49.4% were anaemic and, according to multiple criteria, 43.5% had iron deficiency anaemia, 22.3% iron deficient erythropoiesis, and 6.6% iron depletion. Serum retinol values revealed that 2.5% of the pregnant women were vitamin A deficient, and 31% had marginal vitamin A status. The relative dose response test using 4,000 IU vitamin A, carried out on 45 women, showed that 8.9% had deficient vitamin A liver stores. Serum retinol levels were significantly positively associated ($P < 0.01$) with haemoglobin levels, haematocrit, and serum iron levels. An intervention study involving supplementation not only with iron, but also with vitamin A, was carried out in 1992 to see whether supplementation programmes to improve iron status of pregnant women should be implemented, and this study will be discussed at the meeting.

In Ethiopia, studies have been conducted both in southern Shoa Region, where vitamin A deficiency was not particularly severe, and in Melkaye Village in Hararge Region, where

the prevalence of vitamin A deficiency is probably the most serious ever reported. In southern Shoa, where haemoglobin levels were measured, there was a positive correlation between the concentration of vitamin A in serum and haemoglobin in blood. In Melkaye, there was a strong negative correlation between the concentration in serum of vitamin A with that of ferritin, indicating that vitamin A deficiency inhibits release of iron from the liver.

The studies in rats confirm that in vitamin A deficiency, iron accumulates in liver and that the level of iron in bone, where erythropoiesis takes place, is low. Since the concentration of the iron-transporting protein transferrin is also low, this would indicate that transport of iron from liver to bone is inhibited in vitamin A deficiency.

In conclusion, earlier studies relating vitamin A deficiency to nutritional anaemia have been confirmed, and the effect of vitamin A deficiency is possibly due to a block in the transport of iron from liver to erythropoietic tissues. Thus, in areas with severe anaemia, vitamin A status should also be taken into account when intervention programmes are being considered.

*Department of Human Nutrition, Wageningen Agricultural University, The Netherlands

**Nutrition Research and Development Centre, Bogor, Indonesia

†Ethiopian Nutrition Institute, Addis Ababa, Ethiopia

††Department of Laboratory Animal Science, State University, Utrecht, The Netherlands

SUMMARY OF DIETARY BEHAVIOR POSTER SESSION

S. Smitasiri*

From reviewing the posters in this session, there is much good news for dietary diversification. In India, nutrition education through an ongoing school feeding program is reported to have positive influences on family diets. Also, another Indian community-based intervention project is found effective in creating behavior change through the use of well-designed education materials and mix-media strategy, including backyard kitchen gardens. Bangladesh reports that home vegetable gardens can be grown and what is likely to make them better. In Uganda, qualitative and quantitative methods are used to assess dietary behavior in order to assist with the national policy and plan of action. Last but not least, "instantized" sweet potato products are found

to have emerging promise in promoting more vitamin A in Guatemala.

These posters identify clearly that dietary interventions should be planned based on the firm knowledge of the community. Effective educational approaches are needed in order to promote desirable dietary behaviors. There are some concerns, however, with regard to home vegetable production, since it has been identified by one of the posters that vegetable variety is crucial for frequent consumption by children. Also, noted from the experience in Guatemala were the difficulties facing the new form food strategy, in terms of technology as well as marketing.

*University of Queensland, Australia, and Institute of Nutrition at Mahidol University, Thailand

PREVENTION OF VITAMIN A DEFICIENCY THROUGH BREASTFEEDING PROMOTION: THE ROLE OF WELLSTART INTERNATIONAL

V. Newman, M.S., R.D.* , A. Naylor, M.D.* , Dr. Ph.H., FAAP* , J. Schooley, MPH*

Vitamin A deficiency is rare among breastfed infants, even in parts of the world where vitamin A deficiency is endemic, and this protective effect appears to continue after breastfeeding is discontinued. Through its work in the promotion of optimal breastfeeding practices, Wellstart International is in a unique position to act as a bridge between the community of professionals in developing countries working to promote breastfeeding and those working to prevent vitamin A deficiency.

During the past 10 years, Wellstart International has been providing an intensive, multi-component program of lactation management education (LME) and support for multi-disciplinary teams of health professionals from developing countries. More than 420 pediatricians, obstetricians, nurses, and nutritionists from over 100 teaching hospitals, ministries of health, and other teaching or policy-making organizations in 30 countries are currently participating in this comprehensive program. These professionals (Wellstart Associates) become resources of expertise for their countries and organizations, and many have been influential in developing national programs and/or national centers for in-country training, clinical service, research, and promotion of breastfeeding.

With support from the U.S. Agency for International Development, Office of Nutrition,

Wellstart International has recently published a review of the world literature on vitamin A and breastfeeding during the past 40 years, which translates scientific literature into information that can be readily applied in practical settings. The vitamin A status of lactating women, the effect of maternal vitamin A status on the vitamin A content of human milk, and the adequacy of breast milk as a source of vitamin A have been summarized in this document, as well as the impact of maternal vitamin A supplementation on the vitamin A content of human milk, and on the health of breastfeeding women and their infants. A summary of the document is being sent to all Wellstart Associates, and information from the document has been integrated into the LME curriculum. Wellstart Associates are encouraged to collaborate with vitamin A deficiency prevention programs in building in-country expertise to establish and sustain optimal infant feeding practices. In this and other related ways, Wellstart International is functioning as a liaison and conduit of information between the vitamin A and breastfeeding communities.

*Wellstart International, 4062 First Avenue, San Diego, CA 92103, USA

THE ROCHE SIGHT AND LIFE TASK FORCE: REFLECTIONS ON PAST AND FUTURE ACTIVITIES

J. Gmünder, Ph.D.*

┆ The working principles and activities of the SIGHT AND LIFE task force are reviewed.

┆ Quality management is seen as an important tool in vitamin A work. Factors affecting vitamin A stability are mentioned, and stability data of vitamin A preparations are used to illustrate the term "expiry date."

┆ One component of SIGHT AND LIFE assistance is technical support. Conclusions and experiences relating to "serum retinol assays" and "food fortification" are summarized.

┆ The final solution of the vitamin A deficiency problem is obviously a complex venture with a strong cultural dimension. Health education, social mobilization and community participation are powerful tools to bring about the necessary changes. New education materials for professionals, mothers and children are presented.

*Task Force, SIGHT AND LIFE, P.O. Box 2116, Basel CH-4002, Switzerland

NEW HORIZONS IN VITAMIN A RESEARCH

F. Chytil*

There are quite a few areas of research which recently have gained considerable interest and momentum. All these efforts may eventually lead to elucidation of molecular mechanisms underlying the beneficiary effects of retinoids (derivatives of vitamin A-retinol) on specific diseases in humans. Deciphering the molecular mechanisms of morphological alterations observed in experimental animals as well as humans lacking retinol, which are reminiscent of tissues undergoing malignant transformation, may contribute positively to our knowledge of cancer. Certainly, the list of human diseases where retinoids have been successfully introduced is growing. To the well-known phenomenon that retinol (given usually in the form of ester) could prevent xerophthalmia, the striking effect of this compound on measles has been added. Administration of retinol, again administered as esters, has been found to be beneficiary in lowering the incidence of bronchopulmonary dysplasia in prematurely born human neonates. All-*trans*-retinoic acid, which under physiological conditions arises by oxidation of retinol, is used in the form of an ointment as an active drug for repair and prevention of photodamage of skin. 13-*cis*-retinoic acid, which is the product of isomerization of all-*trans*-retinoic acid, is used as orally applied drug to cure hyperkeratoses of the skin. Most recently, oral administration of all-*trans*-retinoic acid has been shown to delay the fatal consequences of the promyelocytic leukemias.

Retinol, when administered in sufficient quantities, is able to satisfy all needs for retinoids during the whole life of an animal, will remain the main tool of intervention by epidemiologists. On the other hand, recent discovery of other active forms of retinoic acid as the 9-*cis*- and 3,4 didehydroretinoic acid will lead to the intensive search for explanation of the diversity and time-dependent

action of vitamin A. Thus, the old question of the "active" form of vitamin A will be revisited, as from many experimental data it could be concluded that retinoic acid is more active than retinol. Interestingly, retinol appears to be the most active form in the activation of B-lymphocytes necessary for production of antibodies.

The results of the last decade support the original hypothesis that vitamin A exerts its action in the cell nucleus in a manner similar to steroid hormones. Indeed, some people treat, for instance, retinoic acid as a hormone. Thus, vitamin A, probably in the form of retinoic acid, can activate or repress specific genes (at present more than 350 genes were identified) by a receptor-mediated process which involves entrance of retinoic acid into the cell nucleus. Here, interaction of retinoic acid with a family of nuclear proteins called retinoic acid receptors appears to occur. These proteins have the ability to recognize, on the gene influenced by retinoic acid, a specific sequence called retinoic acid response elements. Such interaction leads to activation or repression of a specific gene by a mechanism which is still not known.

Probably the most exciting area of endeavor which has recently received a lot of attention is the role of vitamin A in development. It appears that retinoic acid is a morphogenic compound, i.e. a compound responsible, for instance, for formation of limbs. In other words, vitamin A and its derivatives may be prime candidates for their role in the formation of organs and shape of anatomical structures in general. The intimate mechanisms involved in this phenomenon remain to be elucidated.

*Department of Biochemistry, Vanderbilt University, Nashville, TN 37232-0146, USA

DIET DIVERSIFICATION: TENGERU ACTIVITIES ON VITAMIN A RICH FOODS

*R.E.A. Swai**

Increasing intake of vitamin A from the normal diet is the long term solution of vitamin A deficiency in Tanzania. This is made possible thorough promotion of home gardening and consumption of dark green leafy vegetables, yellow or orange flashed fruits, sweet potatoes and pumpkins. Limiting factors like inadequate supply of vegetable seeds, fruit planting materials and unavailability of technical knowledge on production, processing and preservation of beta-carotene rich foods are being addressed by the Horticultural Research and Training Institute at Tengeru-Arusha.

The poster outlined the types of activities being conducted at Tengeru. The activities include training and research on:

—indigenous vegetables including germplasm collection, maintenance and evaluation.

—vegetable seed production

Since 1990, under the FAO/UNDP vegetable seed production of project, the Centre has produced 13 types of vegetable seeds. These include amaranth, tomato, onion, cabbage, okra, African eggplant, green beans, African leaf cabbage, spider flower, bight shade, cu-

cumber, dolichos beans and leaf mustard. About 2 tons of seed have been produced of which 60 kg were supplied to the Singida horticultural project.

—sweet potatoes

In collaboration with the International Potato-Center (CIP)s surveys have been carried out to determine the role of the sweet potato in the food system in the Northern zone including Singida region. Germplasm from each region has been collected for conservation, evaluation and improvement, some work on processing, preservation and storage is also underway.

—training for farmers

Apart from conducting a two year diploma course in horticulture and refresher courses for extension workers, the Institute conducts one week courses for farmers. They cover aspects of vegetable and fruit gardening at household and community levels. For the period from 1990/91 to 1992/93 a total number of 664 farmers were trained.

*HORTI—Tengeru, Arusha, Tanzania

INFORMATION, EDUCATION AND COMMUNICATION (IEC) IN THE VITAMIN A CONTROL PROGRAM

H. Missano*, S. Maganga*

The aim of IEC as a supportive component of the program is to provide information and education to the community on the causes and the consequences of the problem and measures to prevent it through consumption of foods rich in vitamin A, fat and protein and control of diseases.

Techniques used in IEC were presented as print media and radio. Specific to vitamin A deficiency a package of educational materials has been developed. The package which is in Kiswahili consists of a manual for extension workers as a source of technical information and a reader for the community for future reference.

Calendars produced by TFNC for 1992 (on micronutrient deficiencies) and 1993 (on celebration of 20 years of TFNC) have themes on vitamin A deficiency. They are useful as a general reminder of the vitamin A deficiency problem as well as proposed actions.

A flip chart on the diagnosis and management of vitamin A deficiency and xerophthalmia has been produced. The chart was used in training workshops for health professionals in all the 20 regions of mainland Tanzania on the subject.

Radio is the media which reaches most people and an evaluation of radio programs done in 1991 indicated that they are the main

source of nutrition information to the community. The weekly radio programs which address food and nutrition issues are:

- Chakula na Lishe (Food and Nutrition) by TFNC
- Chakula Bora (Good Food) by Ministry of Agriculture
- Elimu ya Watu Wazima (Adult Education) by Institute of Adult Education
- Afya Bora (Good Health) by Ministry of Health.

Different organizations do publish nutrition information and education articles in zonal rural newspapers, national dailies and periodicals.

The poster also presented limitations in the current IEC component as being inadequate sectoral collaboration, poor needs assessment procedures, faults in dissemination of research findings and poor communication infrastructure.

Future plans were listed as development of the IEC strategy including needs assessment procedures, use of multiple communication infrastructure and building human resource capabilities and institutional capacities handle IEC issues.

*Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania

PRODUCTION OF SUFFICIENT RED PALM OIL FOR MARKETING IN FOUR REGIONS OF TANZANIA (A PILOT PROJECT)

*G.T. Ndunguru**

This pilot project is one of the dietary approaches to increase intake of vitamin A through promotion of production and consumption of red palm oil. Red palm oil is a rich source of provitamin A carotenes as well as oil needed for its absorption.

At present harvesting, processing and marketing of the oil are undertaken by individuals at household level. The production is below demand. Plan is to involve Kyela Rungwe Co-operative Union (KYERUCU) in small-scale commercial production and marketing of the oil. The Government under the health and nutrition project funded by the World Bank is providing seed money for building up the project into a sustainable economic venture.

Tanzania Food and Nutrition Centre which is coordinating these activities has already completed feasibility studies on the produc-

tion and marketing of the oil. When in full scale production, the oil will reach consumers in four regions where vitamin A deficiency is a problem. (Mbeya, Iringa, Rukwa and Ruvuma.) There is also a possibility for the oil to reach other regions outside the zone through appropriate marketing system.

Future plans include setting up a red palm oil processing plant in Kyela under management of KERUCU with TFNC providing technical advice, training technicians on management of the processing plant and promoting consumption of red palm oil through social marketing, communication and nutrition education.

*Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania

A KNOWLEDGE, ATTITUDE AND PRACTICE (KAP) STUDY ON SOCIO-ECONOMIC AND CULTURAL FACTORS AFFECTING THE INTAKE OF VITAMIN A RICH FOODS (THE CASE OF SHINYANGA)

C.A. Kamugisha*, F. Magambo**, J. Kiduanga, C.T. Bwenge

A study conducted in rural Shinyanga in 1988 indicated that vitamin A deficiency (VAD) and xerophthalmia were problems of public health significance in the area.

The second five year program started in 1990/91 and will end in 1994/95. In order to effectively address the basic causes of vitamin A deficiency, KAP-study was conducted aimed at describing current knowledge, attitude and practices related to consumption of vitamin A rich foods as well as identifying constraints hindering successful implementation of the vitamin A deficiency control program strategies.

The KAP study covered approximately 600 households in three divisions in rural Shinyanga. The households were distributed in 6 villages of which 2 had implemented Child Survival Program (CSD) with a vitamin A component whilst 4 villages had not yet implemented the CSD program. Apart from house-

hold interviews, the study included collection of information from village, ward, district and regional level by interviews, discussions and observations.

Findings in the study indicated:

- need for further information and raising of awareness about the problem as only 20% of the mothers showed satisfactory knowledge
- need for an improved processing and preservation technology of fruits and vegetables
- need for continuation of the assessment of vitamin A content in indigenous foods
- need to strengthen efforts for protecting, promoting and supporting breastfeeding with a focus on early initiation and use of colostrum.

*University of Dar es Salaam, Tanzania

**Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania

PRESERVATION OF VITAMIN A RICH VEGETABLES AND FRUITS BY IMPROVED SOLAR DRYING TECHNOLOGY

C. Mgoba*, G. Mulokozi*, C.R. Temalilwa*, F.S. Wandema, Dr. G. Ndossi*

Solar drying is a traditional method of preserving food for off-season consumption. Preservation of vitamin A rich vegetables and fruits by solar drying can extend intake of vitamin A over a longer period in the year and thus reduce the risk of vitamin A deficiency.

The poster presentation outlined traditional procedure for processing and drying foods include blanching, sundrying in open air for 2-4 days and storing in gourds, bins, pots and buckets.

Problems associated with the traditional method are photodegradation of provitamin A carotenoids, longer drying time, susceptibility to contamination by insect, microorganisms, dirt and dust, loss of quality attributes (eg, color) and product loss due to wind and spillage.

Ways to improve traditional technology are shorter time blanching, use of improved solar driers, and use of plastic bags stored in a dry dark place. There is higher retention of carotenoids and minimum product loss. Faster process means less work for women and produces may be used for income generation.

The improved solar drier is an enclosed wooden structure covered with a black and a transparent plastic sheet. The black sheet filters off UV-light which destroys carotenes. Holes are made in the side of the box to aerate the box and the bottom is covered with black painted stones for concentrating solar energy.

Pilot testing of the driers is being conducted in Singida rural district as part of the horticultural project to promote production and consumption of vitamin A rich fruits, vegetables and tubers. The solar drier is suitable for drying of green leafy vegetables, mangoes, papaya, pumpkins and yellow/orange sweet potatoes.

Initial testing for acceptability by the community has proved successful. Upon completion of the pilot testing a manual will be produced for use in other areas with similar climate.

*Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania

Abstracts

SOLAR DRYING VITAMIN A-RICH FOODS

M. Linehan*

The availability of vitamin A-rich foods throughout the year is an important problem for several countries where vitamin A deficiency is a documented problem. In certain areas, such as Haiti and the Dominican Republic, foods such as mangos are very plentiful during a short growing season, but they ripen quickly and large quantities are frequently lost due to lack of transport or preservation methods.

Solar drying technology is being used by women's groups in Haiti and the Dominican Republic to preserve mangos, pumpkin, papaya, sweet potatoes and other foods for consumption during the dry season. Solar dried foods have been found to retain a high level of β -carotene, and can be stored for as long as 4-6 months without losing their nutrient value.

Haiti			
Sample	α -carotene ($\mu\text{g/g}$)	β -carotene ($\mu\text{g/g}$)	RE($\mu\text{g}/100\text{g}$)
Squash	18.0	61.7	1178
Mango	<0.5	60.8	1013
Dominican Republic			
Sample	α -carotene ($\mu\text{g/g}$)	β -carotene ($\mu\text{g/g}$)	RE($\mu\text{g}/100\text{g}$)
Wild Spinach	24.7	240.7	4205
Carrots	156.0	159.0	3950
Papaya	<0.6	0.75	12.5
Parsley	1.32	21.1	362

Women's groups, through Save the Children in Haiti and *Fundación para el Desarrollo Comunitario, Inc.* (FUDECO) in the Dominican Republic, are implementing food preservation activities using solar drying technologies. The acceptability of the dried fruits makes it an attractive food source of vitamin A for children at risk for vitamin A deficiency. The women's groups have developed a variety of recipes utilizing the dried produce, including an instant soup mix and weaning food mixtures. Program components include training in the techniques of food preparation, drying, storage, and marketing. In order to promote the consumption of the dried foods, nutrition education and recipe development have been given special attention. In addition, the projects recognize the importance of income-generation as a primary factor in motivating and sustaining participation in the activity.

*Vitamin A Field Support Project (VITAL), 1616 North Fort Myer Drive, Suite 1240, Arlington, VA 22209, USA

LABORATORY SUPPORT TO VITAMIN A DEFICIENCY CONTROL PROGRAM

P.J. Kihwele*, G. Mulokozi*, C.R. Temalilwa*

Major components of the laboratory support to the program include:

- assessment of vitamin A status in individuals by serum retinol determination by HPLC and by Conjunctival Impression Cytology (CIC)
- determination of carotene content in foods by HPLC

The above methods have been used in several studies for assessment and evaluation purposes.

The laboratory collaborates with several institutions both nationally and internationally. They were listed as:

National: Government Chemical Laboratory, Tanzania Bureau of Standards, Sokoine University of Agriculture and Uyolet Agricultural Research Institute

International: Wageningen Agricultural University (Netherlands), Helen Keller International, Hoffmann La-Roche Nutrient Composition Laboratory, Beltsville, Maryland, and Program Against Micronutrient Malnutrition (PAMM).

Future plans include rehabilitation of equipment, further training of staff and to effectively participate in international program for quality control of analysis of micronutrients.

The poster also presented a table of the beta-carotene content of commonly consumed Tanzanian foods.

*Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania

CHARACTERISTICS OF NON-RESPONSIVE BITOT'S SPOTS IN NEPAL

G.P. Pokharel*, F. Curtale*, C.R. Pant*, Muhilal**, A. Monto†, J. Gorstein†, S. Pak†, R.L. Tilden*¹

Non-responsive Bitot's spots were common among the children examined in the Vitamin A Child Survival Project. The literature suggests that non-responsive Bitot's spots are more common among older children, and are less often seen in younger children. Many non-responsive Bitot's spots were seen in the age cohort 60-120 months; however, the prevalence was only slightly higher in this cohort than in the 48-60 month age cohort. Age appeared to have less association with risk for non-responsive Bitot's spots than did nutritional status. Non responsive Bitot's spots were more likely to occur in children that were taller, more wasted, and had lower levels of adiposity, than in children with Bitot's spots that did respond to treatment.

Traditionally, vitamin A deficiency control programs are targeted to preschool children because of the association between age and risk of non-responsive Bitot's spots. Even though vitamin A programs are cheap and easy to implement, they have not yet been promoted as a component of school health programs for children age 60-120 months. The study population of the Nepal Child Survival Project had greater impact on the health of older children (60-120 months) than on younger children (less than 60 months) in terms of xerophthalmia, wasting and mortality. It appears that young school-aged children might

benefit greatly from inclusion into vitamin A deficiency control programs.

The role of wasting in risk for xerophthalmia in Nepal is pronounced; on the community level, when a village had high risk for xerophthalmia, it also had high risk for wasting. Villages where children had low levels of adiposity were also at elevated risk of xerophthalmia and non-responsive Bitot's spots. In villages where most of the children were stunted, however, xerophthalmia and non-responsive Bitot's spots were not seen. The "biological impact," in terms of risk reduction associated with participation in the program, was also influenced by nutritional status. The capsule was much more effective in reducing risk of Bitot's spots in stunted children than it was among wasted children. Vitamin A can help promote growth, but it cannot take the place of sufficient calories. The control of xerophthalmia in Nepal must also include food security for the rural population.

*Nepal Vitamin A Child Survival Project, Kathmandu, Nepal

**Center for Research and Development of Nutrition, Bogor, Indonesia

†Department of Population and International Health, School of Public Health, University of Michigan

FAO/AUSTRALIA—NUTRITION IMPROVEMENT PROJECT, VIETNAM—A MULTISECTORAL, COMMUNITY-BASED APPROACH TO ADDRESSING FOOD AND NUTRITION PROBLEMS

Dr. J. Badcock*, Prof. T. Giay**

Project GCP/VIE/013/AUL—“Nutrition Improvement with Special Reference to Vitamin A Deficiency through the Increased Production and Consumption of Appropriate Foods”—is an FAO-Government Cooperative project with the Government of Vietnam. The overall objective of the project is the improvement of the nutritional status of vulnerable population groups with special reference to the prevention of vitamin A deficiency in four pilot provinces by the year 1993. Each pilot site represents a different agro-environmental zone in Vietnam. The project was developed in response to the major food and nutrition problems in Vietnam, i.e., undernutrition and vitamin A deficiency in under-fives. It aims to address key causal factors, such as inadequate diet and diet lacking in diversity, poor nutritional knowledge in the community, and traditional infant feeding practices that are detrimental to health.

The major activities of the work plan are the identification of dietary deficiencies, in qualitative and quantitative terms, in selected pilot species and varieties of horticultural crops to be grown in home gardens to correct the identified nutritional problems; the promotion of horticultural crops production with families; and promotion, through nutrition edu-

cation, of the consumption of foods to achieve dietary adequacy and prevent deficiency disease, including vitamin A deficiency. Nutrition education and home garden extension activities are being addressed at community level with training and support for cadres of volunteer nutrition and horticulture educators in each pilot site.

The project being undertaken is jointly implemented in-country by two Ministries (Agriculture and Health) and is addressing nutritional problems as multi-factorial issues involving many sectors (especially including the Women's Union) and addressing a number of causal factors concurrently. The success or not of the link between Agriculture and Health strategies is of key interest as a potential long-term practical approach to solving nutrition problems, including vitamin A deficiency, at community level, and the project is being thoroughly and scientifically evaluated. Baseline data on nutritional status (including vitamin A deficiency prevalence), dietary intakes, nutrition knowledge, and household food production will be presented on the four project sites and two control sites.

*FAO-Chief Technical Adviser, Vietnam Nutrition Improvement Project

**Director, National Institute of Nutrition, Vietnam

RELATIVE PROTECTION OF ONE ORAL 100,000 IU OR 200,000 IU DOSE VITAMIN A AGAINST DEFICIENCY

*J. Humphrey**, *G. Natadisastra***, *Muhilal†*, *D. Friedman**, *J. Tielsch**, *K. West**, *A. Sommer**

The current WHO recommendation for vitamin A prophylactic dosing of children one year of age and older is 200,000 IU every 3–6 months. Recent evidence documenting side effects with this dose prompted us to conduct this randomized controlled trial. High risk children, 12–59 months of age, were identified from a screening survey among nearly 10,000 children. A total of 345 enrolled children were assessed by serum retinol (SR), the relative dose response (RDR) test, ocular examination, anthropo-metric measures, and recent morbidity by maternal history. They were randomly allocated to receive either 100,000 or 200,000 IU vitamin A, and reassessed 3 and 6 months later. Groups were comparable at baseline. At 3 months, the mean SR of the 200,000 IU group was significantly higher compared to the 100,000 IU group. By 6 months, the mean SR was higher, and the proportion

RDR+ lower in the 200,000 IU compared to the 100,000 IU dose group. Further analysis revealed that most of the observed difference was confined to children who were xerophthalmic at baseline, and that the relative benefit of the higher dose was directly related to the severity of baseline vitamin A deficiency. Finally, non-responsive, incident and relapse rates of Bitot's spots were higher in the 100,000 IU group compared to the 200,000 IU. These findings indicate that the WHO recommended dose should not be reduced.

Supported by the Thrasher Research Fund and Cooperative Agreement No. DAN 0045-A-5094 between USAID and the Dana Center.

*Dana Center for Prev. Ophthal., Johns Hopkins Univ., Baltimore, MD, USA

**Cicendo Eye Hosp., Bandung, Indonesia

†Nutr. Res. Dev. Centre, Bogor, Indonesia

VITAMIN A SUPPLEMENTATION: A MUST DURING SUPPLEMENTARY FEEDING IN REFUGEE CAMPS IN ZIMBABWE

*J. Mabika**, *E.M. Mandishona**, *S. Mazonde**, *W. Mukonoweshuro**, *N.Z. Nyazema**

Despite international nutrition guidelines, relief programmes often fail to provide macronutrients such as vitamin A. During the past decade outbreaks of micronutrient deficiency disease affecting tens of thousands have been reported in refugee camps, mainly in Africa. A cross-sectional study was carried out at a refugee camp in Zimbabwe to determine the prevalence of vitamin A deficiency among 2341 school children. This is a refugee camp populated by people from Mozambique, where vitamin A deficiency is high due to drought and war. Results obtained showed that 7% had conjunctival xerosis and 1.5% had Bitot's spots. A case control study was done with 96 children (48 cases and 48 controls), age range 4–8 years. 29% of the cases and 15% of the controls had stayed in the camp for less than 12 months. About 27% of each of the groups had more

than three episodes of diarrhoea and acute respiratory tract infections. More than 30% of each had a history of measles. Little access to extra food was reported by more than 40% of the children. Most of the food was made up mainly of "sadza," a local corn meal and beans. The study showed that there was evidence of clinical vitamin A deficiency in the population studied. Most rations in refugee camps lack adequate vitamin A. Supplementation of vulnerable groups should be routine. Relief programmes, together with the host governments, should work out strategies to avoid micronutrient deficiencies such as vitamin A deficiency. This will be the only way to contain the spread of infectious diseases.

*Medical School, University of Zimbabwe, Harare

INTEGRATION OF THE DELIVERY OF VITAMIN A SUPPLEMENTS TO INFANTS AND POST-PARTUM WOMEN INTO THE ROUTINE IMMUNIZATION PROGRAM ON LOMBOK ISLAND, REPUBLIC OF INDONESIA

A. *Sutanto**, Muharso*, N. Hutter**

The integration of the delivery of vitamin A supplements to infants and post-partum women into the routine immunization program on Lombok Island is one component of a birth-based child survival program (CS-P2) jointly administered by the Ministry of Health (MOH) and PATH (Program for Appropriate Technology and Health), funded by USAID. The program targets 80% of newborns and postpartum women to be visited in their homes within seven days of birth by an EPI service provider trained to provide expanded services. One vitamin A capsule (200,000 IU) is administered to the mother of the newborn, together with tetanus toxoid (TT) immunization and a one-month supply of iron tablets. The newborns are weighed and given OPV-0 and HB-1 immunizations. Mothers are counseled in exclusive breastfeeding, personal hygiene, and supportive home-care for low birth-weight (LBW) infants. Infants are referred to the EPI outreach service post (posyandu) for sequential immunizations and vitamin A supplements. At posyandu, the infants receive one dose of vitamin A (50,000 IU) together with DPT-2 immu-

nization at 10 weeks of age, and a second dose with measles immunization at 36 weeks. Children 1-5 years of age receive a 200,000 IU capsule of vitamin A every 6 months at posyandu. Since the start of the project, integrated services have been delivered to over 15,000 infants and their mothers. Midterm survey data revealed that 74% of infants had been visited at home, of which 81% were visited within 1 week of birth, and, overall, 77% of post-partum women received a capsule of high-dose vitamin A. Health center records show that 85% and 47% of infants 10-36 weeks of age, respectively, received a 50,000 IU capsule of vitamin A, and 84% of children 1-5 years of age were given a 200,000 IU capsule of vitamin A. Integration of the delivery of vitamin A capsules into the routine EPI system has proven to be feasible and successful on Lombok Island.

*Provincial Ministry of Health, West Nusa Tenggara Province (NTB), Indonesia

**Program for Appropriate Technology in Health, NTB, Indonesia

INTEGRATION OF VITAMIN A CAPSULE SUPPLEMENTATION INTO OPERATION TIMBANG: A TEAM APPROACH

C.S. Tuason*, R.D.W. Klemm*

A joint Department of Health (DOH) and Helen Keller International (HKI) project was started in 1990 to increase proportion of high risk groups receiving VAC and to increase the consumption of complete weaning food among 4-11 months old children. This three year project is an expansion of the Vitamin A project (VITEX) in the Philippines to three provinces, namely Quezon, Northern Samar and Zamboanga del Sur:

One of the major interventions of the VITEX project is the integration of vitamin A capsule (VAC) supplementation with the DOH community health services. "Operation Timbang" (OPT), the annual weighing of children 6-83 months was identified as the venue for VAC supplementation. To facilitate the integration of VAC into OPT, a series of trainings on VAD-IDA-IDD was conducted in the three provinces. Emphasis was given on conducting OPT by a team approach whereby community/village volunteers assist the rural health midwife

with the registration of children and weighing, thus allowing the midwife to calculate each child's nutritional status and give appropriate vitamin A supplementation. Immediately after these trainings, OPT was held in the different villages. In August 1992 (5 months after the OPT), a special monitoring study was conducted. Results of the monitoring study showed a high percentage of VAC coverage among the target clients: high risk, xerophthalmia cases, and post-partum women. For high risk cases, for instance, VAC coverage ranges from 52% to 87%. This is high compared to the pre-intervention level of only about 10%. OPT coverage for this year also increased because of VAC supplementation. Based on the results, it appears that the integration of VAC supplementation into Operation Timbang added a new value to an existing activity which the midwife and the community favorably accepted, contributing to the initial success of the integration and high coverage rates.

*Helen Keller International, Philippines

EVALUATION OF THE NATIONAL XEROPHTHALMIA CONTROL PROGRAM INDONESIA 1992

Muhilal*, I. Tarwotjo*, D. Karyadi*, J. Tielsch**

The national xerophthalmia survey conducted in Indonesia in 1978 revealed that the prevalence of X1B in 15 provinces, where xerophthalmia was a public health problem, was 1.3 per 100 preschool children, and that X2/X3 and XS were 11.2 and 16.26 per 10,000 children, respectively.

Given the widespread prevalence of xerophthalmia, an intensive vitamin A capsule distribution program was initiated in 1978, in addition to nutritional education through various channels. To evaluate the vitamin A program, the Government of Indonesia is presently conducting a resurvey of xerophthalmia in the 15 provinces where vitamin A deficiency was found to be a public health problem in 1978. Resurvey was conducted in August to November 1992. The prevalence of X1B appears to be 0.33 per 100 preschool children, and that of X2/X3 and XS are 0.5 and 3.3 per 10,000 children, respectively. This finding suggests that

xerophthalmia is not a public health problem in most of the provinces of Indonesia; however, there are some villages with problems.

To determine the factors influencing the changes of the prevalence of xerophthalmia, data on knowledge, attitude, and practice of mothers, the coverage of capsule vitamin A distribution, and socio-economic level were collected in 1992 survey. The final analysis is not yet completed, but preliminary analysis reveals that coverage of capsules of 200,000 IU vitamin A distribution and vitamin A intake, which is evaluated using IVACG method, contribute to the changes of the prevalence of xerophthalmia.

*Nutrition Research and Development Centre, Ministry of Health, Indonesia

**Dana Center for Preventive Ophthalmology, Johns Hopkins University, Baltimore, MD, USA

INCREASED MORTALITY ASSOCIATED WITH VITAMIN A DEFICIENCY DURING HIV INFECTION

R.D. Semba*, N.M.H. Graham*, J. Palenicek*, W.T. Caiaffa*, A.L. Scott*, L. Clement*, A. Saah*, D. Vlahov*

Introduction

Human immunodeficiency virus (HIV-1) infection and the acquired immunodeficiency syndrome (AIDS) are a major cause of morbidity and mortality worldwide. Nutritional factors which may influence morbidity and mortality during HIV-1 infection are poorly understood. Vitamin A is essential for immune function, and low vitamin A status may be an important risk factor for mortality during HIV-1 infection. Vitamin A status during HIV-1 infection has not been well characterized.

Objectives

The goal of the study is to characterize vitamin A status during HIV-1 infection, and to determine whether vitamin A is related to clinical outcome.

Methods

A cohort of 1393 homosexual men with and without HIV-1 infection has been followed for seven years, and a cohort of over 2000 IV drug users with and without HIV-1 infection has been followed for nearly four years in Baltimore, Maryland. Detailed socio-economic, dietary, and anthropometric data, CD4 cell counts, and other hematological and immunological data were collected. Serum vitamin A levels were measured by HPLC in a masked fashion.

Results

A cross-sectional study of vitamin A status in random sub-sample of 179 IV drug users revealed that over 15% of HIV-1 seropositive individuals had plasma vitamin A levels < 1.05 nmol/L. HIV-1 seropositive individuals had lower mean plasma vitamin A levels than HIV-1 seronegative individuals ($p < 0.001$). Lower vitamin A levels were associated with lower CD4 levels among both seronegative individuals ($p < 0.05$) and seropositive individuals ($p < 0.05$). Vitamin A deficiency was independently associated with increased AIDS-related infectious disease mortality (OR 11.5, 95% CI 3.1-41.1).

Conclusions

This study suggests that vitamin A deficiency may be common during HIV-1 infection, and that low vitamin A status is associated with decreased CD4 T cells and increased mortality during HIV-1 infection. A nested case-control study of vitamin A status and mortality, a nested case-control study of mega-dose vitamin A users, and further cross-sectional studies of vitamin A status in adult and pediatric HIV-1 infected populations are in-progress, and results will be reported at the IVACG Meeting.

*Dana Center, Depts. of Epidemiology, and Immunology and Infectious Diseases, The Johns Hopkins School of Hygiene and Public Health, Baltimore, MD, USA

MOLECULAR MECHANISMS OF ACTION FOR VITAMIN A DERIVED HORMONES*M. Pfahl**

Vitamin A or retinol and its natural and synthetic derivatives (retinoids), influence a large variety of physiological processes, including growth and development, differentiation and morphogenesis, reproduction, vision, and metabolism. Retinoids are used in the treatment of many skin diseases and are promising drugs for several cancers. Consistent with their broad biological activity, retinoids have a variety of side effects that limit their therapeutic potential. A central question for molecular biologists has been how such a large diversity of biological programmes can be controlled by a single vitamin. Understanding of the molecular mechanism, of retinoid action, may lead to the development of more effective retinoid drugs with fewer side effects. It is now clear that, with the exception of vision, essentially all of the physiological processes are controlled by retinoic (RA) isomers. These bind to intracellular receptors, members of the large protein family that also includes receptors for steroid and thyroid hormones, as well as vitamin D₃. These receptors bind DNA and regulate gene activity. Two types of retinoic acid receptors have been identified, the RARs and

the RXRs, each encoded by three genes. Recent progress in our other laboratories has now further elucidated the mechanisms of how these receptors function. RARs are activated by all-*trans*-RA and 9-*cis*-RA, while RXRs respond only to 9-*cis*-RA. RARs require interaction with RXRs, i.e., heterodimer formation, for gene regulation. In addition, RXRs also form dimers with thyroid hormone receptors and the vitamin D₃ receptor. Thus, RXRs play a central role in mediating the signals of several hormones. In addition, RXRs, in the presence of 9-*cis*-RA, form homodimers that can activate different genes. Thus, a complex network of vitamin A or retinoic acid response pathways has been elucidated that now allows a systematic approach for the development of novel retinoids as therapeutic agents. One such group of novel retinoids are our recently described compounds that selectively activate RXRs (Lehmann et. al. 1992, Science 258,1944). These retinoids show promise for the treatment of cancers and other diseases.

*Cancer Center, La Jolla Cancer Research Foundation, La Jolla, CA 92037

IMPACT OF VITAMIN A SUPPLEMENTATION IN PRESCHOOL CHILDREN IN IRINGA, TANZANIA

G.D. Ndossi*, M.C. Latham**, D.A. Roe**, D.D. Miller**, L.S. Stephenson**

A double-blind study was conducted in Iringa, Tanzania, to assess the impact of a single dose of vitamin A (VA) on child growth and morbidity.

Preschool children were randomized to receive VA (*n* = 277) or placebo (PL) capsules (*n* = 277), and followed for approximately 8 months. Both groups were comparable at baseline in terms of age and sex distribution, immunization coverage, nutritional status (NS), and maternal demographic characteristics. Mild to moderate malnutrition was prevalent among children in both groups, and the mean serum retinol level was 17.37 µg/dL. No children had active signs of xerophthalmia.

Following supplementation, children in the VA group had higher but non-significant mean percent weight-for-height (W/H) throughout the study.

Reported morbidity from respiratory disease, fever, malaria, skin infections, and intestinal parasites showed a strong seasonal variation and was not markedly reduced through VA consumption.

We suggest that for children without severe malnutrition, without eye signs of xerophthalmia, and those immunized against measles, etc., high VA capsules are not recommended. Instead, other measures such as fortification, horticulture, de-worming, and control of infections should take higher priority.

*Tanzania Food and Nutrition Centre, P.O. Box 977, Dar es Salaam, Tanzania

**Division of Nutritional Sciences, Cornell University, Ithaca, New York 14853

EFFECT OF VITAMIN A SUPPLEMENTATION ON GROWTH AND MORBIDITY OF PRESCHOOL CHILDREN IN A GROWTH MONITORING RESEARCH PROJECT IN SOUTHERN INDIA

U. Ramakrishnan*, M.C. Latham*, R. Abel*

A randomised, double-blind, placebo-controlled trial was carried out in an ongoing Growth Monitoring Research Project in South India to assess the effects of high-dose vitamin A supplementation on the growth and morbidity of mild to moderately malnourished preschool children. All children were randomly allocated to either 200,000 IU vitamin A or placebo every 4 months. Cases of xerophthalmia and severe malnutrition were excluded. Anthropometric measurements were made at baseline and at the end of one year. Weekly recall of morbidity was also collected by trained village-level workers during the one year follow-up period. Baseline serum retinol, socio-demographics, and KAP of mothers were also evaluated. There were no statistically sig-

nificant differences in growth (Table 1) and morbidity.

Table 1. Relationship of vitamin A supplementation and growth

Mean Change in Growth	Vitamin A (<i>n</i> = 310)	Control (<i>n</i> = 287)
Height (cm/yr)	9.20 ± 3.510	9.01 ± 3.411
Weight (kg/yr)	2.02 ± 0.830	1.99 ± 0.805

The two groups were comparable on major factors, such as age-sex composition, socio-economic status, education, etc. Multivariate analysis confirmed the lack of any effect of vitamin A supplementation on growth and morbidity.

*Division of Nutritional Sciences, Cornell University, Ithaca, NY 14853; RUIISA Dept., Christian Medical College and Hospital, Vellore, India

THE RELATIONSHIP BETWEEN VITAMIN A STATUS AND SEVERITY OF ACUTE RESPIRATORY TRACT INFECTIONS IN CHILDREN

G. Hussey^{*}, L. Dudley^{**}, J. Huskinson^{*}

Acute respiratory tract infection (ARI) is a major health problem for children worldwide in terms of morbidity, mortality, and health service utilization. Mild clinical vitamin A deficiency is associated with an increase in the incidence of ARI, but is there a relationship between vitamin A status and severity of ARI?

This case-controlled study was designed to determine the vitamin A status (serum retinol) of normal children presenting with severe ARI requiring hospitalization ($n = 35$) and mild ARI, requiring out-patient management ($n = 32$), and to assess whether there was an association between severity of ARI and serum retinol. The control group ($n = 54$) consisted of normal children who were admitted to surgical wards and who attended an immunization clinic.

The mean serum retinol levels of children with severe ARI was 13.8 $\mu\text{g/dL}$. This was significantly lower than both the mild ARI group (20.3 $\mu\text{g/dL}$), $p = 0.03$, and the health controls (22.2 $\mu\text{g/dL}$), $p < 0.001$. Ten (28.6%) of

the severe cases had levels $< 10 \mu\text{g/dL}$, indicating severe biochemical deficiency, while only one (1.9%) of the controls, and three (9.4%) of the children with mild ARI had similar levels. There was no correlation between vitamin A levels and nutritional status or age.

In conclusion, this study indicates that a strong association exists between severity of ARI and poor vitamin A status. It is probable that the low retinol levels were the result of the severity of the infection, and not due to pre-existing vitamin A deficiency, since the baseline status of the three groups were similar. High-dose vitamin A supplementation may thus be of benefit to children with acute ARI, as has been the case in children with measles-related pneumonia. This does, however, require validation in controlled clinical trials.

^{*}Department of Paediatrics and Child Health, University of Cape Town, South Africa

^{**}Department of Community Health, University of Cape Town, South Africa

EFFECT OF A SINGLE ORAL DOSE OF VITAMIN A (200,000 IU) ON MORBIDITY IN ACUTE MEASLES CASES RECRUITED AT URBAN CLINICS IN NDOLA, ZAMBIA

F.J. Rosales^{*}, P. Chipaila^{*}, I. Chama^{*}, G. Mukuka^{*}, C. Kjolhede^{*}

Acute non-severe measles cases without signs of xerophthalmia, or previous history of vitamin A treatment, were recruited for a placebo-controlled, double-masked, clinical trial. All enrolled cases were followed for one full month. During the first three days, children were evaluated daily by a physician, and thereafter weekly by a trained field worker. All evaluations included a physical exam and an interview. Any child who became severely ill was referred to a local hospital. Biochemical, immunological, and anthropometric and cellular measurements were assessed during the study. This study was approved by the Com-

mittee for Human Research, School of Hygiene and Public Health, The Johns Hopkins University, and by the analogous body at the Tropical Diseases Research Centre.

The effect of vitamin A on health status will be assessed by comparing the rates of measles severity, or measles-associated morbidities, between the treatment groups, and relating the effect to changes in biochemical, immunological, cellular anthropometric measurements.

^{*}Tropical Diseases Research Centre, Ndola City, Zambia; Johns Hopkins School of Hygiene and Public Health, Baltimore, MD, USA

DETERMINANTS OF VITAMIN A DEFICIENCY IN NORTHERN GHANA

S.S. Morris^{*,**}, B.R. Kirkwood^{*}, P. Arthur^{*,**,*†}, D.A. Ross^{*,**}, J.O. Gyapong^{**,†}, A.M. Tomkins^{††}, R.A. Abbott^{††}, S.M. Filteau^{††}

In a recent trial of the effects of large-dose vitamin A supplements on the health status of children under 5 in Northern Ghana (Ghana Vitamin A Supplementation Trial Child Health Study), serum retinol levels were determined from 1175 children before the start of the trial. The proportion of children with severe (< 0.35 µmol; 15.8%) or moderate 0.35–0.7 µmol; 57.7%) vitamin A deficiency was found to be very high, but many children had normal retinol levels (≥ 1.05 µmol; 5.4%), and some had levels of 2 µmol or over.

As part of the baseline phase of the trial, home interviews were conducted with the main carer of each child, focusing on socio-economic and demographic characteristics of the household and the carer, and including questions on the consumption of vitamin A-rich foods over the last 24 hours, current breastfeeding status and breastfeeding history, and past morbidity history. Following this, a clinical examination was carried out for each child, and a finger-prick blood sample was taken for analysis. Retinol levels were also assessed at four, eight, and twelve months into the trial,

with blood taken from a different 1/3 subsample of the population on each occasion. Data on food consumption were updated monthly, as were data on breastfeeding status.

Socio-economic characteristics of the child's residential compound were found to be strongly associated with its retinol level, and first-born children had higher retinol levels than their higher-order siblings. Poor anthropometric status as measured by height-for-age and, to a lesser extent, weight-for-age, was associated with low retinol, but weight-for-height and MUAC were not. Age at weaning was not associated with retinol levels, but earlier supplementation with solid/semi-solid foods was strongly protective. Consumption of dried beans was significantly associated with serum retinol in the unsupplemented group, whilst large increases in retinol associated with consumption of mangoes and red palm oil did not reach significance.

*London School of Hygiene and Tropical Medicine

** Navrongo Health Research Centre, UER, Ghana

† Ministry of Health, Ghana

†† Institute of Child Health, London

CAN COMMUNITY SERUM VITAMIN A LEVELS BE USED FOR PREDICTING RISK OF XEROPHTHALMIA?R.L. Tilden*, Muhilal**, Tarwotjo**, Atmarita[†], W. Drake*, P. Fajans*

Objectives: Data were analyzed to see how well serum vitamin A values predicted the risk of xerophthalmia, both at the community and individual level, in a large nutrition survey conducted during 1991 in the Eastern Islands of Indonesia.

Methods: Serum vitamin A data was gathered from a sub-sample of children from 240 villages in four provinces, as well as from all children presenting with Bitot's spots. Different cut-off points for individual, and the mean serum vitamin A in communities were used to estimate risk for xerophthalmia.

Results: Using a 10 µg/dl cut-off point, 12.3% of all children were classified as having sub-clinical vitamin A deficiency. The overall mean serum vitamin A level was 19.13 µg/dl, while among children with signs of xerophthalmia the mean level was 11.65 µg/dl and for children with no xerophthalmia the mean vitamin A level was 19.25 µg/dl. Despite these low levels of serum vitamin A, very few cases of active xerophthalmia were observed, with an overall prevalence of 0.14% across all four provinces. At the community level, only 24 of the 240 villages examined contained children with cases of Bitot's spots. A cut-off point for village mean serum vitamin A levels of 20 µg/

dl produced a low relative risk (RR = 1.59) in predicting xerophthalmia but it was possible to identify 70.8% of the children with Bitot's spots. At the individual level, the use of 20 µg/dl as the cut-off point for defining risk gives the highest relative risk (RR = 13.95) for xerophthalmia, and was able to identify 95.8% of the children with Bitot's spots.

Conclusions: The relationship between sub-clinical vitamin A deficiency and an increased risk of mortality has been recently recognized, and would justify vitamin A supplementation even in the absence of xerophthalmia. In countries such as Indonesia where xerophthalmia is disappearing, more work needs to be done to establish heightened risk for mortality with different cut-off points based on serum vitamin A levels, and other measures of vitamin A adequacy before programs should try to be targeted.

*Community Systems Foundation, Ann Arbor, Michigan, USA

**Health Research Section, Ministry of Health, Republic of Indonesia, Jakarta

†Nutrition Unit, Ministry of Health, Republic of Indonesia, Jakarta

SERUM RETINOL AND ACUTE PHASE PROTEINS OF CHILDREN IN NORTHERN GHANA

S.M. Filteau*, S. Morris**†, R.A. Abbott*, A.M. Tomkins*, B. Kirkwood**, P. Arthur**†, D. Ross**†, J. Gyapong†, J. Raynes**

Serum retinol concentration is often used for assessing human vitamin A status. However, since serum retinol decreases during systemic infections, it lacks specificity as a measure of vitamin A status in infected individuals or in populations where there is a high prevalence of infection. Levels of acute phase proteins are elevated in systemic infections, and could potentially be used to control for the effect of infection on serum retinol. To do this, however, it is also necessary to know the effect of vitamin A status on the production of acute phase proteins in response to infection.

Serum retinol and acute phase proteins were measured in samples taken from the Ghana Vitamin A Supplementation Trial Child Health Study. A sub-set of children from each of the vitamin A-supplemented and placebo-treated groups was selected based on assessments of their health, reported by mothers to field-workers, in the two weeks prior to blood sampling. Significant negative correlations were seen between log values of serum retinol and alpha₁-acid glycoprotein (AGT, $r = 0.35$, $p < 0.001$)

and serum amyloid A ($r = 0.20$, $p = 0.004$). Compared to children with normal AGP (≤ 1 g/L), a higher proportion of children with raised AGP would have been classified as severely vitamin A-deficient, and a smaller proportion as vitamin A-adequate based on serum retinol concentration. Synthesis of acute phase proteins in response to a particular illness was marginally greater in the vitamin A-supplemented than the placebo group. The implications of these results for the vitamin A deficiency-infection cycle and for the interpretation of serum retinol values in populations with a high prevalence of infection will be discussed.

This work was supported by the Overseas Development Administration, U.K.

*Centre for International Child Health, Institute of Child Health, 30 Guilford Street, London WC1N 1EH

**London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT

†Ghana VAST Child Health Project

THE STABILITY OF VITAMIN A CIRCULATING COMPLEX IN SPOTS OF DRIED SERUM SAMPLES ABSORBED ON FILTER PAPER

Dr. R.W.A. Oliver*, Dr. E.M. Kafwembe**

66 fresh serum samples recovered from centrifugation of blood collected from Zambian children were immediately analysed for vitamin A using HPLC. Further aliquots (200 μ L) of these serum samples were each applied to 66 small pieces of washed Whatman filter papers, which were then air dried and stored in the dark at room temperature for 5 months. The dried serum spots on filter papers were assayed for vitamin A using a procedure which involves elution of the absorbed vitamin A complex from the filter paper, liberation of the retinol from the complex, extraction, and finally separation by HPLC.

The chromatograms of retinol from both the fresh and the dried serum samples extracts showed no shoulders which would indicate deterioration of the vitamin. The two sets of results showed a correlation coefficient of 0.98, indicating that the two sets of data were linearly related.

$$\frac{[\text{retinol}] \text{ paper}}{(\mu\text{g/dL})} = \frac{[\text{retinol}] \text{ serum}}{(\mu\text{g/dL})} - 0.59$$

Further HPLC investigations to definitely establish that isomerization does not take place on storage are required, but we are of the considered opinion that this has not occurred¹. The major implication of these results is that it greatly simplifies the problem of storage and transport of serum samples to the analytical laboratory, since filter papers with the dried absorbed samples may be sent through the post.

Reference

1. R.W.A. Oliver, E.M. Kafwembe, D. Mwandu, *Clinical Chemistry* (in press), 1992.

*Biological Materials Analysis Research Unit, Department of Biological Sciences, University of Salford, Peel Park, Salford M5 4WT

**Tropical Diseases Research Centre, P.O. Box 71769, Ndola, Zambia

VITAMIN A STATUS IN PRESCHOOL INDONESIAN CHILDREN AS MEASURED BY THE MODIFIED RELATIVE-DOSE RESPONSE ASSAYS. Dawiesah*, M.J. Dibley**, S.A. Tanumihardjo[†]

The modified relative-dose-response (MRDR) assay has been proposed as a reliable indicator of marginal vitamin A status. The method has been validated in animal studies and tested in small samples of preschool children. However, the method has not been applied in a large survey of vitamin A status, nor has the response of the indicator to a high-dose of vitamin A been evaluated in a deficient population. We used the MRDR method to assess the vitamin A status of children in the final treatment cycle of the Morvita Trial. Balanced by treatment group, children were randomly allocated to have the MRDR assay at a given number of weeks following their final trial treatment. Written informed consent was obtained from the child's parents or guardian. The children enrolled were given a dose of 100 µg dehydroretinyl acetate/kg body weight and a high fat snack at home in the morning, and 5 hours later a capillary blood sample was collected by a field nurse. The serum samples were extracted and analyzed in Yogyakarta using standard HPLC methods. 628 blood samples were collected from 82% of the age-eligible children; however 61 specimens could not be processed. A further 26

samples were dropped from the analysis; four because the serum retinol was ≥ 2.1 µmol/L; 13 because the serum dehydroretinol was ≥ 0.14 µmol/L; and the remainder because either serum retinol or dehydroretinol was missing. Thus, we analyzed the results from 546 children, or 71% of the age-eligible children. 257 of these children had been treated with high-dose vitamin A (100,000 IU < 12 months, 200,000 IU \geq 12 months) within the preceding 4 months, while 289 were from the placebo group. The mean dehydroretinol/retinol ratio in the vitamin A treated group was 0.051 (\pm SD of 0.031), but it was 34% higher in the placebo group (0.077 [\pm SD 0.046]). Using the previously proposed cut-off for the ratio of ≥ 0.03 , over 60% of the children treated with vitamin A were classified as marginally deficient. Our data clearly indicate that this cut-off for marginal deficiency should be set at a much higher value.

*Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia

**Division of Human Nutrition, Johns Hopkins University, Baltimore, MD 21205, USA

†Iowa State University, Ames, IA 50011, USA

COMPARISONS OF VITAMIN A ASSESSMENT TECHNIQUES IN INDONESIAN CHILDREN AND FURTHER REFINEMENT OF THE MODIFIED RELATIVE DOSE RESPONSE (MRDR)

S.A. Tanumihardjo*, D. Permaesih*, Muherdiyantiningsih*, A.M. Dahro*, E. Rustan*, Muhilal*, D. Karyadi*, J.A. Olson*

The vitamin A status of two different groups of children were studied in the surrounding areas of Bogor, West Java, Indonesia. Group 1 was selected from an economically depressed village. 75% of the children studied were < 80% of the 50th percentile of WHO weight-for-age standards. Group 2 was a better-nourished group, with 38.5% of the children below 80% of the WHO 50th percentile. The area from which Group 2 was drawn had better living and sanitary conditions.

The methods used for the vitamin A assessment were the modified relative dose response (MRDR) assay, the relative dose response (RDR) assay, and conjunctival impression cytology (CIC). In general, a significant difference ($p < 0.001$) was seen between the MRDR responses of the groups. The CIC also identified Group 1 as being at the greatest risk of deficiency, but did not necessarily identify the same individuals. The RDR gave similar results as the MRDR in Group 2 when a 3.5 μmol

(1000 μg) retinyl acetate dose was administered, but not in Group 1 when a 1.57 (450 μg) dose was used.

The MRDR was also applied to a group of lactating women ($n = 64$) from the surrounding areas of Bogor, using a standard dose of 2.5 mg dehydroretinol equivalents. Two blood samples were drawn from each woman at either 3 and 5 hours or 4 and 6 hours after dosage. A control group consisted of 14 seemingly well-nourished, vitamin A-educated women. At all times studied, the DR/R ratio of the lactating women was about three times higher than that of the control group. The response to the standard dose did not seem to correlate to body weight.

Supported by the Thrasher Research Fund.

*Iowa State University, Ames, IA, USA; Nutrition Research and Development Center, Bogor, Indonesia

RELATION BETWEEN IMPRESSION CYTOLOGY TEST AND TRACHOMA

S. Resnikoff, MD*, S. Farbos, MD*, R. Castan, MD*, P. Huguet, MD*

The Impression Cytology with Transfer test is a sensitive method, allowing the detection of infra-clinical vitamin A deficiencies.

During the use of this method in the Republic of Djibouti (1988) and Mali (1990, 1991, and 1992), we observed a relation between the test results and the existence of an associated conjunctival disease.

After adjustment for age, nutritional condi-

tion and place of residence, it was confirmed that the rate of abnormal tests was two times higher in patients who had inflammatory trachoma than in those who did not.

The consequences of this observation on the use of this test are discussed.

*Institut d'Ophthalmologie Tropicale de l'Afrique (IOTA), BP 248, Bamako, Mali

ASSESSMENT OF VITAMIN A STATUS IN CHINA BY THE MODIFIED CONJUNCTIVAL IMPRESSION CYTOLOGY (CIC) METHOD

Y. Han*, T. Lin*

Conjunctival Impression Cytology (CIC) method was modified to assess vitamin A level more exactly and simply in China. The infants (< 2 years) were sampled in their deep sleep, and the successful rate of sampling was 93%. Dalafield Hematoxylin instead of Harris Hematoxylin was selected to make the result of staining well-observed. A CIC rapid testing box had been made and ready to be used everywhere. About 1000 subjects in different areas with different ages were sampled. There was no vitamin A deficiency in urban (Beijing) children, but those in rural areas (Laiyuan Hebei) were detected to have low vitamin A levels (18.8%). The CIC level in most of the children with the mucus system disease was low. The teenagers' vitamin A deficiency in

rural areas (Gaocheng Hebei) (11.4%) was more than that in the urban (Beijing) (8.0%), because of almost no vitamin A diet intake. The vitamin A nutrition was normal in adults. As the CIC method was compared with the serum vitamin A concentration method, it was found that they were well-corresponded ($r = 0.78$). Thus, the CIC method can be used in populated China to detect vitamin A level. It showed that the number of people who have low vitamin A level by using the CIC method was more than 0.9%, which was determined in the National Nutrition Survey in 1982, so the situation should be further studied.

*Dept. of Food Science, Beijing Agricultural University 100094, Beijing, China

A COMPARISON OF SERUM RETINOL LEVELS AND CONJUNCTIVAL IMPRESSION CYTOLOGY RESULTS IN YOUNG CHILDREN IN GHANA

D.A. Ross***, J. K. Badu**', A. Amidini*, C. Weobong*, E. Awine*, R.A. Abbott††, S.M. Filteau''', A.M. Tomkins''', D.S. McLaren , C. Kjolhede‡‡

Both a finger-prick serum sample and at least one conjunctival impression (CI) were taken from approximately 4000 young children aged 0-96 months, as part of the Ghana Vitamin A Supplementation Trials (VAST), which were carried out in the Kassena-Nankana District in the far North of Ghana, between late 1989 and late 1991.

Serum samples were stored in the dark at -40 C until analysed by HPLC. CIs were taken by touching a small piece of cellulose acetate paper on to the child's conjunctiva, without anaesthesia. The paper was held in the technician's fingers. CIs were then stored in xylene, and stained and mounted according to the ICEPO technique. They were recorded as unreadable if they had fewer than 50 cells on each of the two densest microscopic fields ($\times 10$ objective, $\times 10$ eyepiece) after excluding the peripheral area of the impression. If readable, they were recorded as being "normal" if

they had at least five goblet cells. The presence or absence of mucin spots was not used in the interpretation of the CI result, because preliminary studies showed that there was low agreement between readers on this. The results of a comparison between the concurrent serum retinol level and the CI cytology result will be presented, both in terms of the prevalence of normal and abnormal results, and in terms of sensitivity and specificity.

*Ghana Vitamin a Supplementation Trials (VAST), Navrongo, Ghana

**London School of Hygiene and Tropical Medicine, London, UK

‡School of Medical Sciences, Univ. of Science & Technology, Kumasi, Ghana

††Institute of Child Health, London, UK

‡‡12 Offington Ave., Worthing, W. Sussex BN14 9PE

§§Johns Hopkins School of Hygiene and Public Health, Baltimore, MD, USA

ASSESSMENT OF VITAMIN A STATUS BY A PROTOTYPE DARK ADAPTOMETER

*N. Congdon**, *J. Humphrey**, *D. Friedman**, *L. Clement**, *G. Natadisastra***, *A. Sommer**, *L.-S.-F. Wu**

A total of 244 preschool Indonesian children, most of whom were vitamin A deficient by other indicators, were evaluated by a prototype hand-held scotopic sensitivity machine before and after receiving either a high-dose of vitamin A ($\geq 100,000$ IU) or placebo. Before testing, children were subjected to binocular partial bleaching, followed by 10 minutes of dark adaptation in a dark room. Subjective readings were taken by placing the machine over one eye, and increasing light intensity until the child could successfully discriminate stimulus from non-stimulus under conditions of forced choice on three successive trials; scotopic sensitivity was measured objectively by increasing light intensity until a consensual pupillary response in the fellow eye was visible to the observer under red illumination. Among 73 children with completed RDR and

serum retinol levels, subjects with abnormal objective dark adaptation (DA) scores had higher RDR than normal children (6.6 vs -8.4, $p < 0.05$), while children with abnormal subjective scores had lower (NS) serum retinol than normal children (29.0 vs 22.0, $p = .1$). Among children with serum levels < 20 , scotopic sensitivity of subjects receiving a large dose of vitamin A improved compared to those receiving placebo: (10.20 vs -0.01 log foot-lamberts, $p < 0.05$ for subjective; -0.22 vs -0.11 log foot-lamberts, $p = 0.2$ for objective). Further results correlating DA scores with CIC and clinical indicators of vitamin A deficiency will be reported.

*The Dana Center for Preventive Ophthalmology, Baltimore, MD, USA

**Cicendo Eye Hospital, Bandung, Indonesia

RISK FACTORS FOR XEROPHTHALMIA IN NEPAL

S.K. Khatry*, R.P. Pokhrel*, S.C. LeClerq**, J. Katz**, K.P. West, Jr.**

Xerophthalmia is a major public health problem in Nepal and in South Asia. Previous studies suggest that poor socio-economic conditions and childhood infection, especially diarrhea, are strongly associated with xerophthalmia in Nepal^{1,2}. As part of the baseline ocular survey for a large vitamin A interventional trial³, an epidemiologic study was conducted to help establish a common high-risk profile for xerophthalmia in this region.

A total of 4318 children 60 months of age and younger, living in 40 randomly selected wards in the Sarlahi District project area, were examined for xerophthalmia following standard WHO criteria⁴. Families were evaluated by socio-economic and demographic criteria, and children were assessed for anthropometric and current breastfeeding status, and a 1-week parental history of morbidity was recorded.

No xerophthalmia was observed during infancy. Among children 12 to 60 months of age, 3.4% had xerophthalmia. The rate increased with age and was slightly more common in boys. Children were two to three times more likely to have xerophthalmia where the head of household was illiterate, a day laborer, where housing conditions were poor, or where few household assets were owned. Goat ownership was strongly protective, possibly reflecting a nutritional influence through milk

consumption. Mothers of xerophthalmic children were more likely to have had \geq one child ever die compared to mothers of non-xerophthalmic children. Cases had a nearly three-fold higher risk of dysentery in the past week than controls.

Similar findings have been reported from previous studies in Nepal^{1,2}, Bangladesh⁵, India⁷, and Indonesia⁸, providing a highly reproducible risk profile for mildly xerophthalmic children in South and Southeast Asia.

References

1. L. Brilliant, et. al., Bull WHO 1985, 63:375.
2. M.P. Upadhyay, et. al., Am J Epidemiol 1985, 121:71.
3. K.P. West, Jr., et. al., Lancet 1991, 338:67.
4. A. Sommer, [Field Guide], 2nd ed., WHO: Geneva 1982.
5. A. Hennig, et. al., Bull WHO 1991, 69:235.
6. N. Cohen, et. al., Soc Sci Med 1985, 21:1269.
7. K. Vijayaraghavan, et. al., Lancet 1990, 2:1342.
8. L. Mele, et. al., Am J Clin Nutr 1991, 53:1460.

This study was supported by R&D/N, USAID, Task Force Sight and Life, and UNICEF Nepal.

*Nepal Eye Hospital and Nepal Netra Jyoti Sangh, Kathmandu, Nepal

**Dana Center, Johns Hopkins University, Baltimore, MD, USA

VILLAGES IN TRANSITION: ELEVATED RISK OF MICRONUTRIENT DEFICIENCY

W.D. Drake^{*,***,†}, S. Pak^{*,†}, I. Tarwotjo^{††}, Muhilal[‡], J. Gorstein^{*,†}, R. Tilden[†]

Some researchers have suggested that, as villages move from traditional living patterns emphasizing self-sufficiency to ones featuring economic development, there is a vulnerable transition period in which families of the community are at greater health risk. This elevated risk results from many factors, such as employment volatility, changes in food consumption patterns, composition of the extended family, temporary migration, and child-rearing behavior. Elevated risk, if present, would strike hard at children, who are most vulnerable and readily reflect adverse changes in family status.

Analysis of data from the Eastern Islands of Indonesia supports this hypothesis of elevated risk during transition. Villages in the study area were ranked by a classification system used in Indonesia to measure level of development ranging from traditional agricultural villages, to modern, market-oriented villages. This ranking system not only is related to the amount of infrastructure available in the community, but also includes many other factors. The approach followed takes advantage of the multitude of parameters measured in this study by portraying joint risk of vitamin A deficiency, iodine deficiency disorders, and iron deficiency anemia, as well as other health indicators, such as measles, worm infestation, and diarrheal diseases. By examining community-level prevalences for all three micronutrient deficiencies, this methodology offers unique opportunity to study how the risk for these conditions co-vary at the community level, and thus provides important information for targeting communities with integrated control program activities. Amongst all villages

with high prevalences of any of the three micronutrient deficiencies, there is a 70% "overlap" in risk between at least two of the three micronutrients, with 22% of the villages being at high risk for all three micronutrient deficiencies.

Villages in transition are shown to have higher prevalences of total goiter rate, lower mean hemoglobin levels, higher helminthic infection rates, and higher prevalences of wasting and underweight malnutrition, all at statistically significant levels. They also tend to have slightly higher prevalences of low serum retinol, although not statistically significant with the sample sizes in this study. While focusing upon the villages in transition is but one type of targeting, there is a qualitative difference between this and other targeting strategies. In this instance the targeting can be based upon *anticipating* the risk, rather than reacting to risk estimates based on surveys. Because the government is both planner and resource allocator for its development programs, difficulties experienced during movement through a transition period can be monitored and dampened by allocating special integrated activities to the region receiving development assistance.

*Community Systems Foundation, Ann Arbor, MI, USA

**School of Natural Resources and Environment, University of Michigan

†Department of International Health, School of Public Health, University of Michigan

††Nutrition Directorate, Ministry of Health, Republic of Indonesia, Jakarta, Indonesia

‡Center for Research and Development in Nutrition, Bogor, Indonesia

EXPERIENCES IN TRAINING AND USE OF MODIFIED VERSIONS OF THE IVACG SIMPLIFIED DIETARY GUIDELINES

*M. Mansour**

Modifications to the IVACG Simplified Dietary Assessment Guidelines are currently being refined, and have been incorporated into the nutrition components of several vitamin A deficiency prevalence assessments in Uganda, Cameroon, the Philippines, Papua New Guinea, Haiti, and Panama. Experience with the training and use of the modified guidelines in each setting has been rich and varied, and demonstrates the need for careful adaptation of the methodology to the local context, not only in terms of implementation, but also in terms of interpretation and analysis. For example, the Usual Pattern of Food Consumption component was modified from estimating monthly intake to a seven-day food frequency that takes into account portion sizes. Other modifications included reformatting the questionnaire to allow for instant calculation of the Consumption Index (CI) and the Usual Pattern of

Food Consumption (UPF) scores. In Papua New Guinea food portion size was estimated using photographs; in other instances, cardboard cut-outs representing various foods were used.

In addition to the assessment of populations at risk of inadequate vitamin A intake, further innovations involved using the qualitative information to identify significant dietary sources of vitamin A, patterns of intake by meal, and provided a basis for nutrition education program development.

These modifications were developed in collaboration with local institutions, including Ministries of Health, universities, and national nutrition research institutes during training in use of the methodology.

*Vitamin A Field Support Project (VITAL), 1616 North Fort Myer Drive, Suite 1240, Arlington, VA 22209, USA

A SIMPLE METHOD TO ASSESS VITAMIN A INTAKE: EXPERIENCE WITH A FOOD FREQUENCY QUESTIONNAIRE FOR PRESCHOOL CHILDREN IN RURAL CENTRAL JAVA, INDONESIA

Th. Ninuk S.H.* , M.J. Dibley** , M. Serdula† , T. Sadjimin†† C.L. Kjolhede**

Until recently, there were no simple methods to identify populations with low vitamin A intakes. Traditional dietary assessment methods are labor-intensive, time-consuming, and produce data which are difficult to process and analyze. For these reasons, we developed a food frequency questionnaire to assess vitamin A intake of preschool children who were participating in a community trial of high-dose vitamin A supplementation. The objective was to describe patterns of intake of vitamin A-rich foods and to identify factors influencing this intake. A secondary objective was to classify the children by level of vitamin A intake for use as a co-factor in the analyses of the trial. The food frequency questionnaire was developed using IVACG guidelines, with steps including brief surveys to identify candidate foods, to determine portion sizes, and to pilot test the questionnaire, and development of a method to calculate the vitamin A score. We asked the mother or guardian about the usual consumption of 59 foods during the previous month. Food frequency data were collected every 4 months over a period of two years, starting in December 1989. The results reported are based on 5570 questionnaires administered in seven data collection cycles in 1990 and 1991, to children aged 6 to 51 months, from 34 coastal villages in southern central Java. The median vitamin A score for the age group less

than 12 months was 291 RE. However, the score increased to reach a plateau of 459 RE for children 30 months and older. There were no differences in the vitamin A intake score between males and females. During the one-month recall period, 93% of the children were reported to have eaten chicken eggs, 89% amaranth, 83% carrots, and 83% banana. Both eggs and amaranth were each eaten on average more than eight times per month. Among children less than 12 months of age, the top five foods with the highest mean percent contribution per child were breast milk (47%), carrots (12%), chicken liver (8%), amaranth (4.6%), and eggs (4.5%). Among children 24 months of age and older, the top five contributors were carrots (16%), red sweet potatoes (12%), amaranth (8.8%), spinach (8.5%) and chicken liver (7.5%). These data suggest that carrots, sweet potatoes, and amaranth might be suitable foods to target in future dietary interventions, since they already make an important contribution to vitamin A intake, thus implying both their acceptability and availability in this community.

*Nutrition Academy, MOH, Yogyakarta, Indonesia

**Johns Hopkins University, Baltimore, MD, USA

†Division of Nutrition, Centers for Disease Control, Atlanta, GA, USA

††CE&BU, University of Gadjah Mada, Yogyakarta, Indonesia

VALIDATION OF THE HKI FOOD FREQUENCY METHOD TO IDENTIFY COMMUNITIES WITH VITAMIN A DEFICIENCY

N.L. Sloan*, D. S. Rosen*

Traditional methods to identify vitamin A deficiency (VAD) have been logistically or technically problematic. HKI has developed a semi-quantitative food frequency method to identify communities where VAD is a significant problem in preschool-aged children. This field-oriented method excludes foods with low vitamin A content (< 100 RE per 100 g), and does not elicit information on portion sizes or food preparation, differentiating it from the IVACG or other dietary methods.

This method was validated against serum retinol levels in the Philippines, Guatemala, and Tanzania. In each country, five communities were selected at random from areas of suspected deficiency. A total of 730 children aged 1–5 years were sampled (approximately 50 per community). The food frequency lists and survey training were completed in 5 days.

Using referent points of weighted intake ≤ 6

days per week, and of animal sources of retinol ≤ 4 days per week, seven of eight (sensitivity = 87.5%) communities where $\geq 15\%$ of children had serum retinol levels < 20 $\mu\text{g/dL}$ were correctly predicted to have a VAD problem ($p < 0.000$, $p = 0.067$, respectively; $n = 15$). Four of seven (specificity = 57.1%) communities were correctly identified as not having a VAD problem by the same criteria. Three of seven (42.9%) communities were incorrectly identified as likely to have a VAD problem. This method correctly identified 11 of 15 communities (73.3%) as having or not having a VAD problem.

We conclude that the HKI food frequency method is a practical and valid predictor of vitamin A deficiency in countries where VAD is a suspected public health problem.

*Helen Keller International, 15 W. 16 St., NY, NY

ASSESSMENT OF THE DIETARY INTAKE OF VITAMIN A BY PRESCHOOL INDONESIAN CHILDREN BY TWO METHODS

J. Humphrey*, D. Friedman*, G. Natadisastra**

The IVACG Simplified Dietary Assessment (which includes a 24-hour history and a food frequency) and the Helen Keller International one-week food frequency method were used to assess dietary vitamin A intake of 265 preschool Indonesian children. Children were part of a larger study in which vitamin A status was measured objectively by ocular examination, serum retinol, and relative dose response before, and 3, 6, and 9 months after, receiving a large dose of vitamin A. Dietary interviews were carried out at 9 months. A list of 47 vitamin A-rich foods from the study area was compiled. Next, a pilot study was carried out among 170 children, in which mothers were interviewed about their child's intake of each of the 47 foods. Usual portions were weighed, and age-food-specific median portion sizes were calculated. Mothers were randomly administered the IVACG method or the HKI method; two weeks later, they were adminis-

tered the other method. Using either frequency method, reported intakes were very high and did not correlate with baseline objective measures of vitamin A status. Using the 24-hour history method, reported intakes were within the expected low range and correlated with baseline serum retinol concentrations and the RDR. In this population, where sources of vitamin A are abundant and available throughout the year, the 24-hour history appears to be a better indicator of risk of vitamin A deficiency in the community than food frequency methods.

Supported by the Thrasher Research Fund and Cooperative Agreement No. DAN 0045-A-5094 between USAID and the Dana Center.

*The Dana Center for Preventive Ophthalmology, Baltimore, MD, USA

**Cicendo Eye Hospital, Bandung, Indonesia

A SIMPLIFIED FOOD FREQUENCY METHOD TO ASSESS RELATIVE VITAMIN A INTAKE

*R.J. Stoltsfus**, K.M. Rasmussen*, M. Hakimi*

We developed a food frequency instrument to assess mothers' vitamin A (VA) intakes in a randomized, double-blind trial of vitamin A supplementation during lactation. At 2 weeks post-partum, 153 mothers in rural Central Java received a VA supplement or placebo. Dietary VA intake was assessed to examine its relationship with other measures of VA status, and to control for potential differences between treatment groups. The instrument was developed according to recent IVACG guidelines. The questionnaire included 42 foods, but only 18 contributed $\geq 10\%$ to the total VA intake of at least one mother. To explore how the instrument could be further simplified, we determined which foods were most informative about the mothers' relative VA intake. These foods were not necessarily those that contributed the greatest amount of VA to the diet. At 3 months post-partum, total VA intake was weakly associated with serum and milk retinol concentrations, and women with low intakes benefitted most from supplementation.

These relationships were even stronger when the sub-set of only three foods was used to indicate VA intake. A possible explanation is that total VA intake is less precise because it is the sum of many variables, of which all contain measurement error, but only some of which contain meaningful variability. For many purposes, a measure of relative VA intake within the population is needed. In such cases, a very simple instrument may suffice. Developing a population-specific instrument based on only a few foods requires greater start-up time, but may produce more precise data, reduce interviewer and respondent fatigue, and greatly simplify data management and analysis.

Supported by Thrasher Research Fund and an NSF Graduate Fellowship to R.J.S.

*Div. of Nutr. Sci., Cornell Univ., Ithaca, NY; Faculty of Medicine, Gadjah Mada Univ., Yogyakarta, Indonesia

Abstracts

PRODUCTION, VITAMIN A CONTENT, AND CONSUMER ACCEPTABILITY OF AN "INSTANTIZED" SWEET POTATO PRODUCT PREPARED IN THE FORM OF A GRUEL BEVERAGE OF PUREE PASTE: EXPERIENCE IN GUATEMALA

C.Y. Lopez*, O. Calderon**, S. Schwartz†, J. Quan*, L. Portocarrero*, L.M. Soto**, A. Esquite**, I. Mendoza*, J. Bulux*, N.W. Solomons*, J. Barrows††

Sustaining a food-based strategy to protect the vulnerable child population from vitamin A deficiency in a hypovitaminosis A-prone nation such as Guatemala presents both its problems and its opportunities. Sweet potato grows well throughout the republic, but its consumption as a tuber is limited. Using an industrial process analogous to that for "instantized" potato buds, 6000 lbs. of high-land-grown sweet potato (*Ipomoea batata*) (with 177 retinol equivalents—RE—per 100 g wet weight vitamin A activity, 100% as all-*trans*- β -carotene) were processed into 950 lbs. of finished product (with 958 RE per 100 g of buds, a mixture of all-*trans* and *cis*- β -carotene). The acceptability of recipes for a gruel: constituted with 30 g of product (287 RE, providing about 75% of the child's daily intake requirement), 12 g of sugar and 240 mL of boiled water, and for puree: constituted with the same amount of product and sugar, but with 120 mL of water, was tested. The test was performed in 50 maternal-child dyads on two occasions. Both serving forms appeared to be equally accepted by mothers and their pre-

school children. Left to their own devices, community mothers created pancakes and sweet and salty pies, and added milk, egg, and spices to the recipes. A low-land harvest of the same variety of sweet potato had analyzed vitamin A activity of 73 RE per 100 g wet weight, while an improved, experimental variety grown in the same fields contained 4425 RE. If the latter were processed into an instantized form, it would have an intensely orange color, but would theoretically deliver about 7000 RE per 30 g serving. In an anti-hypovitaminosis A, public health strategy based on real foods, and targeted at under-six-year-olds, processed, "instantized" products have emerging promise.

*Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM), Guatemala 01011

**Institute of Agricultural Science and Technology (ICTA), Guatemala

†Department of Food Science, North Carolina State University, Raleigh, NC 27695

††International Eye Foundation, Bethesda, MD 20814

DIETARY HABITS AND β -CAROTENE RICH FOOD INTAKES OF CHILDREN (6-12 YEARS OF AGE) PARTICIPATING IN THE DR. M.G.R. NUTRITIOUS MEAL PROGRAMME

R.P. Devadas*, S. Premakumari**

A statewide massive nutritious meal programme is in operation in the State of Tamil Nadu, India, which provides a single hot meal with cereal, pulse, and green leafy vegetables and other vegetables as ingredients, to nearly 9 million children belonging to the 2+ to 14+ age group. The children and their mothers are educated to include green leafy vegetables in their daily diet.

In a study of 1000 children participating in noon meal scheme in Coimbatore district, apart from the nutritional benefits due to participation, a reduction in clinical manifestation of vitamin A deficiency from 7% to 2% was evident. Awareness scores of mothers increased from 56 to 70% due to the "carry home"

effect of nutrition education. Changes in dietary habits were also evident, in that 80% of the children studied included green leafy vegetables in their diet at least four times a week, and the rest at least three times a week. Mothers expressed that this change in meal pattern was the result of participation of their children in the noon meal cum education programme. Percolation of knowledge, changes in attitudes and practices in terms of family diets were thus evident.

*Vice Chancellor and **Reader, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore 641 043, India

ASSESSMENT OF DIETARY BEHAVIOR RELATED TO VITAMIN A IN UGANDA

L. Sserunjogi*

A qualitative and quantitative dietary assessment of vitamin A intake was conducted as part of a large Blindness and Vitamin A Deficiency Survey in Kamuli District, Eastern Uganda. The aims of this component were: a) to ascertain vitamin A foods locally available, b) to describe cultural patterns affecting consumption of vitamin A foods, and c) to explore the effects of intra-family food distribution on vitamin A intake of children. Using IVACG Guidelines, both a 24-hour dietary recall and a weekly food frequency history were obtained for 210 children below the age of six years. Additionally, four focus group discussions were held with mothers, and one group of mothers demonstrated local preparation of certain indigenous vitamin A-rich foods. The most common dietary sources of vitamin A were green leafy vegetables and fruit. Although leafy vegetables were the most available source of vitamin A, most mothers qualitatively re-

ported that the greens were coarse, bitter, and unpalatable for young children. Fruit was identified as the most acceptable vitamin A source for children, though it was only seasonally available. The quantitative assessment showed that over half (133/210, 63%) of the children in all age groups were at risk of inadequate vitamin A intake. In summary, vitamin A-rich foods are available in the study communities, but seasonal availability and cultural practices affecting intra-family food distribution determined quality and quantity of vitamin A intake of children. Proposals to change vitamin A-related dietary behaviour should be linked with qualitative and quantitative studies of community food availability, selection, and utilization, particularly for children.

*Child Health and Development Centre, Makerere University, Kampala, Uganda

THE IMPACT OF VEGETABLE VARIETY ON CHILDREN'S VEGETABLE CONSUMPTION IN BANGLADESH

A.K. Tabibul*, A. Talukder*, G. Hall*, M.W. Bloem*

Vitamin A is an important factor in maintaining child health. In Bangladesh, vegetables are the most important dietary source of vitamin A, but intake levels are frequently inadequate, especially in children. There is a need to find ways to improve long-term dietary intake of vitamin A, and so this study examined various SES and vegetable availability factors that may affect vegetable consumption in children under 5 years of age in Bangladesh.

Information was collected from 150 families involved in a home gardening project in a village in rural Bangladesh. 29 months after

commencement of the project, a significant increase in frequency of vegetable consumption was found in children under 5 years of age. A more frequent intake was found to be associated with older age and availability of more variety of vegetable types. The study concludes that the number of different types of available vegetables is an important factor for increasing the frequency of vegetable consumption in young children.

*Helen Keller International, P.O. Box 6066, Gulshan, Dhaka-1212, Bangladesh

VITAMIN A DEFICIENCY IN THE SOUTH PACIFIC: TUVALU, VANUATU, SOLOMON AND COOK ISLANDS

Ministry of Health of Tuvalu, Department of Health of Vanuatu, Department of Health of the Solomon Islands, Cook Islands Ministry of Health, G. Hawley*, M. Linehan*, M. Dreyfuss*

In 1989-92, a series of xerophthalmia surveys were conducted in high-risk malnutrition areas of Tuvalu, Vanuatu, the Solomon and Cook Islands to determine if vitamin A deficiency poses a public health problem. Children aged six months to six years were examined for eye signs and symptoms of xerophthalmia. Families of the children were interviewed to assess health and socio-economic conditions. An assessment of dietary intake was conducted using a food frequency questionnaire and simple anthropometric measurement was carried out on a sub-sample of the children to determine vitamin A food sources and nutritional status.

Xerophthalmia was not found in Tuvalu,

Vanuatu, or the Cook Islands, and the mean frequency of consumption of vitamin A-rich foods was nine, 12, and 10 times per week, respectively. In the Solomon Islands, 1.52% of the surveyed population had one or more active clinical signs or symptoms of xerophthalmia. Children with xerophthalmia consumed vitamin A-rich foods significantly fewer times per week (6.5) than clinically normal children (8.4 times per week).

Survey findings have been used in program planning, including supplementation and nutrition education.

*Vitamin A Field Support Project, (VITAL), 1616 North Fort Myer Drive, Suite 1240, Arlington, VA 22209, USA

THE ASSESSMENT OF VITAMIN A DEFICIENCY IN THREE CITIES IN MOZAMBIQUE

M. Julien*, L. Canotilho, B. Cogill, M. Samussudine, A. Mbeve, F. Xerindza, T. Mungwambe

A cross-sectional survey of 10,267 children aged 6–72 months was conducted in November 1990 to assess the extent of vitamin A deficiency (VAD) using WHO criteria, so that a suitable control strategy could be developed. The survival impact of vitamin A prophylaxis was not investigated.

Information collected during the survey included clinical examination for eye signs as a proxy indicator of VAD, location, age, gender, length of residence, presence of ocular pathology, treatment, frequency of consumption of key foods, illness patterns, feeding practices, and levels of malnutrition.

The findings indicated a small prevalence of 0.7% of VAD. Characteristics such as stability in residency, frequency of oil consumption, number of meals, age, breastfeeding status, and nutritional status were significantly associated with VAD signs.

While child gender did not affect the rate of VAD, older children between the ages of 12 and 48 months were at greatest risk. Among completely weaned children, those identified as malnourished using Mid-Upper-Arm Circumference (< 13.5 cm) were at significantly higher risk of VAD ($p < .001$), while malnutrition was more evident in children aged 6 to 24 months. This relationship between nutritional status and rate of VAD was most evident in Beira, Mozambique's second largest city. Controlling for age, location, frequency of consumption of vitamin A-rich foods, number of meals, and breastfeeding, children shifting from being categorized as malnourished to better-nour-

ished increased their odds for absence of VAD signs by almost three-fold, using a logistic regression model.

Analysis of dietary patterns indicated that a lower consumption of vitamin A-rich foods was only weakly associated with increased risk of VAD signs, especially in Beira. Controlling for breastfeeding, the younger child recently arrived to the city and being part of the internally displaced population consumed less vitamin A-rich foods. Families that fled the war and economic destruction from the rural areas were significantly more likely to have malnourished children with VAD signs ($p < .001$).

The findings are consistent with other African countries, suggesting low levels of VAD due to regular but small intakes of vitamin A in foods. Acute stressing factors, such as PEM brought about by poverty, social stress and related war, precipitate a more serious VAD. Due to limited resources in Mozambique, we suggest a health facility-based distribution of moderate doses of vitamin A for children seeking care for acute diseases. Targeting of children of the displaced requires additional supplementation. Promotion of the consumption of vitamin A-rich foods, together with an improvement of the economic and security situation, is seen as a necessary pre-condition to eliminating vitamin A deficiency in the country.

*Ministry of Health, Nutrition Section, Caixa Postal 203, Maputo, Mozambique

KAMULI BLINDNESS AND VITAMIN A DEFICIENCY SURVEY

*Dr. M. Kawuma**

Between October and December 1991, a study on Vitamin A Deficiency and Blindness Assessment was carried out in the Kamuli district of Uganda. The study was sponsored by UNICEF and VITAL. Full anthropometry assessment was also carried out on xerophthalmic children, their control, and a group of subsamples. Measurements and analysis of weight for age, height for age, weight for height, and mid-upper-arm circumference were used to assess the physical development of these children. The highest prevalence of wasting (low weight for height) occurred among xerophthalmic children. Prevalence of stunting (low height for age) and underweight (low weight

for age) was relatively common among all children above the age of 12 months, because of the wide-spread malnutrition in the district. 20 children among the xerophthalmic children had grossly delayed developmental milestones, as compared to only two among the control group of children. The incidences of respiratory infection, diarrhoea and fever were all higher among xerophthalmic children, with respiratory infection rate showing figures of 76% among xerophthalmic children and 18% among the control children.

*Makerere University, Department of Ophthalmology, P.O. Box 7072, Kampala, Uganda

VITAMIN A DEFICIENCY IN THE DOMINICAN REPUBLIC

*H.R. Mendoza, MD**

A survey was undertaken in the most economically depressed (southwest) region of the country to determine retinol levels in blood and dietary intake of vitamin A-rich foods among a representative sample of children from one to five years of age. A total of 648 children of both sexes and from one to five years of age were studied. A dietary assessment was conducted using the IVACG Simplified Dietary Assessment Guidelines to determine children's risk of inadequate intake of vitamin A. This methodology involved the calculation of a Consumption Index (CI) to assess intake in the past 24 hours, and the Usual Pattern of Food Consumption (UPF) to assess long-term consumption habits. Blood was drawn from the children for the determination of retinol.

31 and 44% of children showed a moderate-to-high risk of poor intake by CI and UPF, respectively, mainly in those one to three years of age, and coming from the urban areas. Because the study was done during the mango season, risk scores were recalculated excluding mangoes from the scores, finding an in-

crease of children at risk with the CI (94%) and the UPF (84%), mainly in children from the rural areas. 20% of the children had retinol levels of less than 20 $\mu\text{g}/\text{dL}$.

The study indicates that in the southwest region of the country, vitamin A deficiency is a health problem. Mango was shown to be an important dietary source seasonally, and indicates that solar drying of mangoes may be an appropriate intervention. Implementation of mango-drying activities began in April 1992.

The relationship between the CI/UPF and serum retinol was tested, with the objective of determining the usefulness of CI and/or UPF as a risk indicator. The UPF was found to have high sensitivity, but very low positive predictability.

*Centro Nacional de Investigaciones en Salud Materno Infantil (CENISMI), Santo Domingo, Dominican Republic; Institute for Nutrition for Central America and Panama (INCAP), Guatemala City, Guatemala; Vitamin A Field Support Project (VITAL), 1616 North Fort Myer Drive, Suite 1240, Arlington, VA 22209, USA

THE VITAMIN A INTAKE OF LACTATING AND NON-LACTATING NON-PREGNANT WOMEN IN RURAL WEST-JAVA AND LOCAL FOOD RESTRICTIONS WHICH LIMIT THEIR VITAMIN A INTAKE

S. de Pee*, C.E. West*, W.A. van Staveren*, Muhilal**, D. Karyadi**, J. G.A.J. Hautvast*

Data on vitamin A intake of lactating and non-lactating non-pregnant women were collected in four rural villages in Bogor district, West-Java. A vitamin A intake questionnaire and questions about food restriction were administered to 21 lactating and 20 non-lactating non-pregnant women per village.

The vitamin A intake questionnaire developed used a food frequency format. The IVACG guidelines for developing a vitamin A intake questionnaire were used in order to become familiar with local food consumption and preparation practices, and for food availability investigations. Based upon the findings from the preliminary observations and interviews, the format for the food frequency questionnaire was chosen. For the 30 most consumed provitamin A-rich vegetables, women were asked about the frequency of cooking per week or month, whether the vegetable was prepared alone and/or mixed with other foods (such as vegetables, tahu, salted fish), what amount of the vegetable was used, and with what frequency. In that way, the very variable ways of preparing vegetable dishes which influence the portion size to a large extent were taken into account. To estimate the portion eaten, the women were asked with how many people they shared the dish. For calculation of intake, equal portion sizes were assumed. For vegetable consumption from dishes not self-prepared, a question was added about fre-

quency of consumption of bought and received dishes. For most frequently consumed (pro)vitamin A-rich fruits, milk products, eggs, fish, and meat, the questions were as follows: how many times do you take or buy the following foods, in what quantity, and which part do you eat yourself? Fat intake was estimated from the amount of oil used for cooking, which appeared to contribute the largest part of the fat intake. The last question of the questionnaire dealt with consumption of vitamin preparations. Vitamin A content of the foods were taken from Indonesian, East Asian (FAO), and Malaysian food composition tables, and the intake of nutrients was calculated from food intake using the MICRONAP programme for food consumption calculations. Questions about food restrictions were asked at another meeting with the respondents. Each woman was asked which foods she did not eat, for what reason, and for how long.

Data on vitamin A intake and food restrictions limiting the vitamin A intake will be presented for the total of 84 lactating and 80 non-lactating non-pregnant women interviewed, and comments will be given on the methodology used to estimate vitamin A and fat intake.

*Department of Human Nutrition, Wageningen Agricultural University, Wageningen, The Netherlands

**Nutrition Research and Development Centre, Bogor, Indonesia

BOLIVIA VITAMIN A DEFICIENCY PREVALENCE ASSESSMENT

A. Botelho*, MA, E. Lara*, R. Lopez*

During 1991, the Ministry of Public Health of Bolivia carried out a vitamin A deficiency prevalence survey in a random sample of children between one and five years of age, living in the poorest areas of the country. The sample of 1000 was stratified by ecologic zone (altiplano, valle, llano) and by urban/rural location. The survey evaluated serum retinol by the method of Bessey and Lowry, and risk of inadequate vitamin A consumption per IVACG Simplified Dietary Assessment Guidelines. It revealed an overall prevalence of serum retinol below 10 $\mu\text{g/dL}$ (deficient) of 0.1%, and below 20 $\mu\text{g/dL}$ (low) of 11.3%; 48.3% had serum retinol concentrations below 30 $\mu\text{g/dL}$. The highest prevalence was found in the rural areas of the "altiplano," 17.6% low, and the "llanos," 12.9%. The results of the survey were

presented during a national seminar and three regional workshops attended by personnel of public and private institutions who, after interpreting the results, recommended the components of a comprehensive program to reduce vitamin A deficiency. The National Department of Nutrition and the National Committee on Deficiency Diseases have developed the National Vitamin A Program around these recommendations, and have begun implementation in coordination with the regional sanitary units, NGOs and local units of the Ministries of Education and Agriculture.

*Department of Nutrition, Ministry of Public Health, La Paz, Bolivia; Vitamin A Field Support Project (VITAL), 1616 North Fort Myer Drive, Suite 1240, Arlington, VA 22209, USA

THE PREVALENCE OF VITAMIN A DEFICIENCY AND IRON DEFICIENCY ANEMIA OF PRESCHOOL CHILDREN IN PANAMA

E. De Caballero*, D. Nelson**

The Department of Nutrition conducted an assessment of vitamin A deficiency and iron deficiency anemia in a national random sample of 1600 children 12–59 months of age. Children in systematically selected double-census segments in four health regions, representing 96.7% of the total population, were screened for clinical signs of xerophthalmia, measured for height and weight, and had a 4 mL venous blood sample taken. Each child's mother or caretaker was interviewed to assess the child's risk of inadequate intake of vitamin A-rich foods using a modification of the IVACG Simplified Dietary Assessment Guidelines. The data collection was conducted by eight two-person teams of a nurse and a laboratory technician trained to collect the required data, standardized prior to the initiation of survey data collection, and supervised by MOH nutritionists and laboratory staff throughout the survey.

Blood samples were taken to regional laboratories where hemoglobin and hematocrit values were calculated. The samples were then sent to INCAP in Guatemala, where retinol levels were analyzed using spectrophotometry. Data were entered and analyzed in Panama City using EPI INFO software, and the find-

ings will be discussed.

Analysis of retinol levels revealed that 6.1% of the sample were less than 20 $\mu\text{g}/\text{dL}$ (low), and that 28.2% were less than 30 $\mu\text{g}/\text{dL}$ (marginal), indicating that vitamin A deficiency is not a national public health problem in Panama. However, disaggregation of the sample by ethnicity showed that the indigenous populations had significantly lower retinol levels, with prevalence rates 2, 13, and 47% for severe (10 $\mu\text{g}/\text{dL}$), low, and marginal levels, respectively.

Using a modified version of IVACG's Simplified Dietary Assessment methodology, VITAL found that 47 and 37% of the children were at moderate to high risk of poor intake by Consumption Index (CI) and Usual Pattern of Food Consumption (UPF), respectively.

Indigenous children showed significantly higher prevalence rates in the moderate to high risk groups, 63% by CI and 51% by UPF.

*Department of Nutrition, Ministry of Public Health, Panama; Institute for Nutrition for Central America and Panama (INCAP), Guatemala City, Guatemala

**Vitamin A Field Support Project (VITAL), 1616 North Fort Myer Drive, Suite 1240, Arlington, VA 22209, USA

Abstracts

PREVALENCE OF XEROPHTHALMIA AND RISK OF VITAMIN A DEFICIENCY AMONG CHILDREN IN THE EXTREME NORTH PROVINCE OF CAMEROON

E.A. Atina*, M.R. Wilson**

A survey to determine the prevalence and causes of blindness, visual impairment, and the risk of vitamin A deficiency in the Extreme North Province of Cameroon was conducted between April 17 and May 22, 1992.

Screening for xerophthalmia was conducted on 5000 children under the age of six, randomly selected from a multi-stage, clustered sample stratified by ecological zone. Dietary assessment and anthropometric measurements were carried out on a 20% systematic sub-sample, plus cases and controls matched for age and sex.

A modified version of the IVACG Simplified Dietary Assessment Guidelines was used to assess the risk of inadequate intake of vitamin A. Venous blood was collected on a non-representative sub-sample of children and serum retinol determined using HPLC.

Results

54% of eligible children were found to be at high risk of inadequate vitamin A intake. 22%

of the serum retinol samples were "low" (< 20 µg/dL). 31 children (.61%) had clinical signs of xerophthalmia with 24 (.5%) having Bitot's spots. The prevalence of xerophthalmia differed among four topographical regions from a high of .91% in the flood plains region to .12% in the plains. Findings will be presented at the IVACG meeting and at national information dissemination workshops to help design national policy and possible follow-up interventions.

*Nutrition Service, Ministry of Public Health, Yaoundé, Cameroon

**Charles R. Drew University of Medicine and Science, Los Angeles, CA, USA

Other collaborators included Vitamin A Field Support Project (VITAL), 1616 North Fort Myer Drive, Suite 1240, Arlington, VA, USA and Organization de Coordination pour la lutte contre les Endémies en Afrique Centrale (OCEAC), Yaoundé, Cameroon

THE IMPLICATIONS OF URBANISATION FOR VITAMIN A DEFICIENCY AMONGST CHILDREN IN SOUTH AFRICA

A. Coutsoudis*, D. Mametja*, C.C. Jinnabhai*, H.M. Coovadia*

Increased urbanisation of rural populations has led to approximately 7 million South Africans living under appalling conditions on the fringes of major cities. It is likely that vitamin A status of children in such conditions may be compromised. Accordingly, we assessed the vitamin A status of children living in a representative peri-urban informal settlement. We also used the opportunity to field-test the feasibility of the conjunctival impression cytology (CIC) test, which has not been previously used in South Africa.

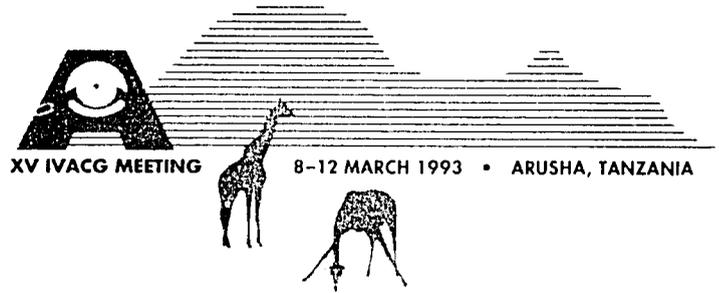
A random representative sample of 190 pre-school children (3–6 years of age) was selected from Besters, an informal settlement within metropolitan Durban, South Africa. The following investigations were performed: anthropometry, serum retinol and CIC. For the CIC one specimen was taken from the inferior temporal conjunctiva of each eye.

No child had obvious clinical signs of vitamin A deficiency. The mean serum retinol of 169 children tested was $20.8 \pm 7.4 \mu\text{g/dL}$ (mean \pm SD). Nine children (5%) had vitamin A defi-

ciency (serum retinol $< 10 \mu\text{g/dL}$), and 75 children (44%) had poor vitamin A status as defined by serum retinol $< 20 \mu\text{g/dL}$. CIC was performed in 185 children, and revealed that 18% had poor vitamin A status as defined by two abnormal conjunctival specimens. Serum retinol levels in the abnormal and normal CIC groups were significantly different.

The CIC test was a feasible and reproducible method for field studies; however, it correlated poorly with the traditionally accepted serum retinol threshold of deficiency, in this population where overt vitamin A deficiency is not prevalent. In conclusion, this survey has demonstrated that, regardless of the measurement tool, there is a prevalence of sub-clinical vitamin A deficiency in this typical peri-urban informal settlement and accordingly we suggest that these children should be targeted for intervention strategies.

*Department of Paediatrics & Child Health, University of Natal, P.O. Box 17039, Congella, 4013, South Africa



Participants

Local Participants

Akm Ashraf ul Alam

UNICEF
PO Box 4076
Dar es Salaam

P.T. Assey

PO Box 3032
Arusha

Mr. V. Assey

TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mr. P.O. Blomquist

Project Officer
UNICEF
PO Box 4076
Dar es Salaam
Telephone: 255-51-46463
Facsimile: 255-51-46772
Telex: 41103 UNICEF TZ

Mr. Eric Boateng

Programme Officer
UNDP
PO Box 9182
Dar es Salaam
Telephone: 255-51-46711
Facsimile: 255-51-46718
Telex: 41284

Mrs. Hellen Bradburn*

Regional Agriculture Department
(Nutritionist)
PO Box 3163
Arusha

Dr. Anthony D. Bulengo

Public Health Consultant
PO Box 8112
Arusha
Telephone: 255-57-2605
Telex: 42028

Mr. P. Chikira*

Regional Planning Office, R.D.D.
PO Box 3050
Arusha

Mr. Saidi Chizenga

PO Box 65385
Dar es Salaam
Telephone: 255-51-71446

Mr. Saidi H. Chomeka (MP)

Mbunge wa Uzini
PO Box 362
Zanzibar
Telephone: 255-54-30171

Mr. E.J. Damball*

Regional Water Engineer
PO Box 3020
Arusha

Dr. E.A. Duale

Representative
World Health Organization
PO Box 9292
Dar es Salaam

Ms. E.C. Ekström*

Nutrition Officer
World Health Organization
PO Box 9292
Dar es Salaam
Telephone: 255-51-46613
Facsimile: 255-51-38282
Telex: 41280 Lishe TZ

Dr. Nicholas N. Eseko*

Regional Medical Officer
Ministry of Health
PO Box 3092
Arusha

Ms. Yvonne Jannifer Guga

Tutor, Food Science
Ministry of Agriculture
HORTI-Tengeru
PO Box 1253
Arusha
Telephone: 94 Duluti

Ms. Joyce Hamisi

Executive Secretary
Presidential Trust Fund
PO Box 70000
Dar es Salaam
Telephone: 255-51-29711

Mr. Nicodemus Ikonko

Uhuru and Mzawendo Newspapers
PO Box 3143
Arusha

Mrs. R.M. Kakande

Coordinator of Nursing Affairs
Commonwealth Regional Health
Community Secretariat for East,
Central and Southern Africa
PO Box 1009
Arusha
Telephone: 255-57-2961
Telex: 42121 AICC TZ

Mr. S.H. Kasori

Protocol Officer
R.D.D.'s Office
PO Box 3050
Arusha

Mr. S. Katala

Helen Keller International
PO Box 76
Dodoma
Telephone: 255-61-22444
Facsimile: 255-61-22444

Dr. S.B. Katenga

Ministry of Health
PO Box 9083
Dar es Salaam
Telephone: 255-51-20261

Dr. Godlove Ernest Kavavila

Paediatrician
Arusha Regional Hospital
Ministry of Health
PO Box 3092
Arusha
Telephone: 255-57-3351

Dr. F.P. Kavishe*

TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Dr. F. Kawau

Muhimbili Medical Centre
PO Box 65015
Dar es Salaam
Telephone: 255-51-27081

*Member, Local Organizing Committee

Participants

Mr. Mzee Rajab Khatib
Ministry of State Planning
PO Box 874
Zanzibar
Telephone: 255-54-30189

Prof. C. Kihamia
Muhimbili Medical Centre
PO Box 65000
Dar es Salaam
Telephone: 255-51-26211

Dr. S. Kimboka
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621/28951

Prof. S.N. Kinoti
Commonwealth Regional Health
Secretariat for East, Central and
Southern Africa
PO Box 1009
Arusha
Telephone: 255-57-8361
Facsimile: 255-57-8292
Telex: 42121 AICC TZ

Mr. M. Kweba
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mr. C.S. Lamosai
Commissioner of Income Tax
Income Tax Department
PO Box 9131
Dar es Salaam
Telephone: 255-51-26231

Dr. Ingrid Lewis
Network Vegetable Production
Africa Project
PO Box 8182
Tengeru
Arusha

Mr. James Lolida
Regional Administration
PO Box 7032
Arusha

Mrs. C. Lukwaro*
World Vision International
PO Box 6070
Arusha
Telephone: 255-57-34475
Facsimile: 255-57-8248
Telex: 42078 WORVIS TZ

Mrs. F. Magambo*
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mrs. S. Maganga
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe Tz

Dr. K. Manji
Muhimbili Medical Centre
PO Box 65000
Dar es Salaam
Telephone: 255-51-26211

Mrs. B.R. Mansur
Ministry of Community
Development
Women and Children
S. L. P. 3448
Dar es Salaam
Telephone: 255-51-46399

Sr. Juliana Materne
S.N.M. Lumuma Dispensary
Helen Keller International
PO Box 297
Mpwawwe

Mrs. M. Materu*
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mrs. N. Mbando
Helen Keller International/
Tanzania
PO Box 76
Dodoma
Telephone: 255-61-22444
Facsimile: 255-61-22444

Mr. T.J. Mbowe
PO Box 113
Shinyanga

Dr. R.O. Mbwasi
Ministry of Health
PO Box 9083
Dar es Salaam
Telephone: 255-51-20261

Dr. B. Mduma*
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 42180 Lishe TZ

Mr. M.N. Meghji
HORTI-Tengeru
PO Box 1253
Arusha
Facsimile: 255-57-8254
Telex: 42115 CAMART TZ

Mrs. Zakia Meghji
Deputy Minister of Health
Ministry of Health
PO Box 9083
Dar es Salaam

Mr. C. Mgoba
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-20261
Facsimile: 255-51-28951
Telex: 41290 Lishe Tz

Sr. Avelina Michael
PHC Coordinator
Helen Keller International
PO Box 922
Dodoma
Telephone: 21965/24462

Dr. Peter N. Mihale
Primary Health Care Institute
Ministry of Health
Iringa Regional Hospital
PO Box 235
Iringa
Telephone: 255-64-2143

Mrs. H. Missano*
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

*Member, Local Organizing Committee

Participants

Mr. Charles Mkomwa*
Conference Manager
Arusha International Conference
Centre
PO Box 3081
Arusha

Dr. B.B.O. Mmbaga
Country Director
Helen Keller International
PO Box 1323
Dodoma
Telephone: 255-61-22444
Facsimile: 255-61-22444

Dr. Nameus Mnzava
Horticulturalist and Training
Officer
AVRDC Africa Regional Office/
CONVERDS
PO Box 10, Duluti
c/o HORTI-Tengeru
Arusha
Facsimile: 255-57-8220

Mrs. T.N. Mollel*
Regional Planning Office, R.D.D.
PO Box 3050
Arusha

Mr. B.B. Momburi
Ministry of Minerals
PO Box 903
Dodoma

Mr. E. Moyo
Ministry of Agriculture and
Livestock Development
PO Box 9192
Dar es Salaam
Telephone: 255-51-29027
Telex: 41246 Kilimo TZ

Mr. L. Mselle
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-74105
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mrs. Rehema Mshana
Health Coordinator, Northern Zone
World Vision International
PO Box 221
Same, Kilimanjaro Region
Telephone: 84 Same

Mrs. Msuya*
TANESCO
Arusha

Mr. T. Mtaita
Helen Keller International/
Tanzania
PO Box 76
Dodoma
Telephone: 255-61-22444
Facsimile: 255-61-22444

Mrs. Habiba Mtinda
Ministry of Community
Development, Women's Affairs
and Children
PO Box 3448
Dar es Salaam

Mrs. G. Mulokozi
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-74105
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mrs. Judith S. Muro
Ministry of Agriculture and
Livestock Development
PO Box 9192
Dar es Salaam
Telephone: 255-51-29027
Telex: 41246 Kilimo TZ

Ms. Rose Msanya Mushi
Nurse Tutor
Kilimanjaro Christian Medical
Center
School of Ophthalmic Nursing
PO Box 3012
Moshi
Telephone: 54377
Telex: 43158

Mr. A. Mwaisemba
KYERUCU
PO Box 413
Kyele

Mrs. Tatu Mwaruka
Joint Consultative Group on Policy
(JCGP)
PO Box 320
Shinyanga

Ms. Janet T. Mwenda
Farmers Education Publicity
Officer
Raldo's Office
PO Box 3084
Arusha
Telephone: 255-57-3431

Dr. L.A. Mwijage
Bariadi Hospital
PO Box 17
Bariadi

Dr. Nashara P.R.M.
Mt. Meru Hospital
PO Box 3092
Arusha
Telephone: 255-57-8664

Mrs. Ndeki*
CEDHA
Arusha

Dr. G.D. Ndossi*
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mr. G.T. Ndunguru
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-74105
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Prof. A.M. Nhonoli
Commonwealth Regional Health
Secretariat for East, Central and
Southern Africa
PO Box 1009
Arusha
Telephone: 255-57-8362
Facsimile: 255-57-8292
Telex: 42121 AICC TZ

Dr. Kwasi P. Nimo
Medical Officer
World Vision International
PO Box 6070
Arusha
Telephone: 255-57-34475
Facsimile: 255-57-8248
Telex: 42078 WORVIS TZ

*Member, Local Organizing Committee

Participants

Mr. M. Njwete

Helen Keller International/
Tanzania
PO Box 76
Dodoma
Telephone: 255-61-22444
Facsimile: 255-61-22444

Mr. D.L.M. Nonga

Department of Agriculture and
Livestock Development
PO Box 26
Singida

Mr. Peter S. Ntukula

Tanzania Tea Blenders
PO Box 2663
Dar es Salaam
Telephone: 255-51-30031

Ms. E.R. Nutting

Radio Tanzania Zonal
Correspondent
PO Box 1236
Arusha

Mr. S. Nyagwegwe

Ministry of Agriculture and
Livestock Development
PO Box 21
Masasi

Mr. Nyaki*

Ministry of Community
Development, Women's Affairs
and Children
PO Box 3050
Arusha

Dr. Romeo Opeña

Plant Breeder and Director
AVRDC Africa Regional Centre
(CONVERDS)
PO Box 10, Duluti
c/o HORTI-Tengeru
Arusha
Facsimile: 255-57-8220

Mr. A.B. Paulo

KILIMO
PO Box 107
Kigoma

Mr. Madan Rai

Horticulturist
FAO Seed Expert
Seed Project
HORTI-Tengeru
PO Box 1253
Arusha
Telephone: 255-57-8493

Mr. John Raymond

Tanzania News Agency
PO Box 6028
Arusha

Mr. C. Rutaiwa*

RDD
PO Box 3050
Arusha

Ms. M. Rweramira

TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Dr. Marilyn J. Scudder

Head, Eye Department
Kilimanjaro Christian Medical
Center
PO Box Private Bag
Moshi
Telephone: 54377

Mrs. S. Shao

Senior Librarian
TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mr. Epafra Shoo

Senior Ophthalmic Nursing Officer
Dispensing Optician
Machame Lutheran Hospital
PO Box 3044
Moshi
Telephone: 23 Machame

Dr. Winnie Mpanju-Shumbusho

Asst. Coordinator for Health
Research
Commonwealth Health Secretariat
for East, Central and Southern
Africa
PO Box 1009
Arusha

Telephone: 255-57-8361

Facsimile: 255-57-8292

Telex: 42121 AICC TZ

Ms. Catherine Siandwazi

Commonwealth Regional Health
Secretariat for East, Central and
Southern Africa

PO Box 1009

Arusha

Telephone: 255-57-8362

Facsimile: 255-57-8292

Telex: 42121 AICC TZ

Mrs. M.E. Sila*

TFNC

PO Box 977

Dar es Salaam

Telephone: 255-51-29621

Facsimile: 255-51-28951

Telex: 41280 Lishe TZ

Dr. L.B.J. Siyame

Mbeya Referral Hospital
PO Box 419
Mbeya
Telephone: 255-65-2156

Dr. W. Slaa

Tanzania Society for the Blind
PO Box 2254
Dar es Salaam

Mrs. Mwajuma M. Suleiman

Box 159

Zanzibar

Mr. R.E.A. Swai

HORTI-Tengeru

Arusha

Facsimile: 255-57-8254

Telex: 42115 Camart TZ

Mr. S.S. Swai*

Regional Planning Office, R.D.D.
PO Box 3050
Arusha

*Member, Local Organizing Committee

Mr. C.R. Temallwa*

TFNC
PO Box 977
Dar es Salaam
Telephone: 255-51-29621
Facsimile: 255-51-28951
Telex: 41280 Lishe TZ

Mrs. Nancy Tesha

RDD's Office
PO Box 3070
Moshi
Telephone: 255-55-50377

Mr. Daniel Toole

Deputy Representative
UNICEF
PO Box 4076
Dar es Salaam
Telephone: 255-51-46463
Facsimile: 255-51-46772
Telex: 41103 UNICEF TZ

Dr. M.J. Wanjara

Mt. Meru Hospital
PO Box 3092
Arusha
Telephone: 255-57-3351

Mr. A.B. Yatera*

Posts and Telecommunications
Arusha

*Member, Local Organizing Committee

International Participants

Dr. Iyabo Adeyefa

University of Ibadan
Department of Human Nutrition
Ibadan
Nigeria
Telephone: 234-22-415405
Facsimile: 234-22-412412
Facsimile 2: 234-22-417135

Mr. David Alnwick

Senior Advisor (Micronutrients)
UNICEF
Program Division, H-10F
3, United Nations Plaza
New York, NY 10017
USA
Telephone: 212-326-7057
Facsimile: 212-326-7336
Telex: 391 611181 UNCF BR

Mrs. Victoria Alvarado

Vitamin A Project Coordinator
Fundacion Internacional del Ojo
(International Eye Foundation)
Colonia 15 de Septiembre, T-34
Comayaguela
Honduras
Telephone: 504-331-531
Facsimile: 504-331-823
Facsimile 2: 301-986-1876 IEF/USA

Dr. Maina Boukar Amsagana

Health Department Director for
Tahoua
Ministry of Public Health, Niger
c/o Ms. Sylvia Etian
USAID/Niamey
Washington, DC 20521-2420
USA
Telephone: 227-72-30-49
Facsimile: 227-72-39-18
Facsimile 2: 227-73-29-63

Ms. Laurie Lindsay Aomar

Project Manager, IVACG
Secretariat
The Nutrition Foundation, Inc.
1126 Sixteenth Street, NW
Suite 700
Washington, DC 20036
USA
Telephone: 202-659-9024
Facsimile: 202-659-3617
Telex: 6814107 NUTFOUND

Dr. Dyna Carol Arhin

Health Policy Unit
Department of Public Health and
Policy
London School of Hygiene and
Tropical Medicine, Keppel Street
London WC1E 7HT
United Kingdom
Telephone: 44-71-927-2262
Facsimile: 44-71-463-3611
Facsimile 2: 44-71-436-5389
Telex: 8953474

Prof. Jaime Ariza

University of Puerto Rico
GPO Box 362156
San Juan
Puerto Rico
Telephone: 809-758-2525
Facsimile: 809-759-6719
Facsimile 2: 809-767-0755

Mr. Jacob Gabriel Akwetey Armah

Regional Nutrition Officer
Ministry of Health
Nutrition Division
PO Box M-78
Accra
Ghana
Telephone: 233-21-665001
Facsimile: 233-21-662210 GNCC

Dr. Paul Arthur

Maternal and Child Epidemiology
Unit
Dept. of Epidemiology and
Population Science
London School of Hygiene and
Tropical Medicine, Keppel Street
London WC1E 7HT
United Kingdom
Telephone: 44-71-927-2089
Facsimile: 44-71-436-4230
Facsimile 2: 44-71-436-5389
Telex: 8953474

Dr. Emmanuel Atud Atina

Nutritionist
Ministry of Public Health
Nutrition Service, DFMH
Yaounde
Cameroon
Telephone: 237-232-232 OCEAC
Facsimile: 237-230-061 OCEAC
Facsimile 2: 237-237-786

Dr. Tola Atinmo

Principal Investigator
Nigeria Micronutrient Survey
University of Ibadan
Department of Human Nutrition
Ibadan
Nigeria
Telephone: 234-22-415405
Facsimile: 234-22-412412
Facsimile 2: 234-22-417135

Dr. Atmarita

Head, Nutritional Status
Monitoring Section
Directorate of Community
Nutrition
Ministry of Health
Jl. H.R. Rasuna Said Blok 8-5, Kav
4-9
Jakarta 12950
Indonesia

Telephone: 62-21-520-1590

Facsimile: 62-21-521-0176

Dr. Bal Gopal Baldya

Honorable Member
National Planning Commission
Kathmandu
Nepal
Facsimile: 977-1-226500

Dr. Mauricio L. Barreto

Department de Medicina
Preventiva
Universidade Federal da Bahia
Rua Pedro Feijo
29-4-and-Canela
40140 Salvador Bahia
Brazil
Telephone: 55-71-245-9003
Facsimile: 55-71-245-8562
Facsimile 2: 55-71-237-5856

Participants

Mr. John M. Barrows

Child Survival/Vitamin A
Coordinator
International Eye Foundation
7801 Norfolk Avenue
Suite 200
Bethesda, MD 20814
USA
Telephone: 301-986-1830
Facsimile: 301-986-1876

Prof. George Beaton

Department of Nutritional
Sciences
University of Toronto
Faculty of Medicine
FitzGerald Building, 150 College
St.
Toronto, Ontario M5S 1A8
Canada
Telephone: 416-978-4697
Facsimile: 416-978-5882

Dr. Krishna P. Belbase

Project Officer
UNICEF/Botswana
Box 20678
Gaborone
Botswana
Telephone: 267-352752
Facsimile: 267-351233
Telex: 2867 BD

Dr. B. de Benoist

Regional Advisor in Nutrition
Regional Office for Africa
World Health Organization
PO Box 6
Brazzaville
Republic of the Congo
Telephone: 242-8338-61
Facsimile: 242-8318-79
Telex: 5217 KG

Dr. Martin W. Bloem

Country Director
Helen Keller International
PO Box 6066 Gulshan
Dhaka 1212
Bangladesh
Telephone: 880-2-325628
Facsimile: 880-2-813310
Telex: 642940 ADAB BJ

Mr. Jeffrey Brown

Project Manager, Projecto
Vitamina A
International Eye Foundation
Hospital Rodolfo Robles
Diagonal 21 y 19 Calle, Zona 11
Guatemala City 01011
Guatemala
Telephone: 502-9-511-374
Facsimile: 502-9-511-374
Facsimile 2: 301-986-1876 IEF/USA

Dr. Jesus Bulux

Chief, Task-Force on Vitamin A
and Micronutrients
CeSSIAM
Hospital de Ojos y Oidos
Diagonal 21 y 19 Calle, Zona 11
Guatemala City 01011
Guatemala
Telephone: 502-2-730375
Facsimile: 502-2-733906

Dr. Susan Burger

Vitamin A Manager
Helen Keller International
90 Washington Street
15th Floor
New York, NY 10006
USA
Telephone: 212-943-0890
Facsimile: 212-943-1220

Ms. Ann Burgess

Nutrition Consultant
Craiglea Cottage, Glenisla
Blairgowrie, Scotland
PH11 8PS
United Kingdom
Telephone: 44-57582-218

Dr. Barton Burkhalter

Senior Program Officer
Academy for Educational
Development
1255 23rd Street, NW
Washington, DC 20037
USA
Telephone: 202-862-1900
Facsimile: 202-862-1947

Mrs. Dolline Busolo

Community Nutritionist
Kenya Energy and Environment
Organization (KENGO)
PO Box 48197
Nairobi
Kenya
Telephone: 254-2-748281
Facsimile: 254-2-749382
Telex: 25222 KE

Ms. Karen Canova

Information Program Officer
VITAL
1616 N. Fort Myer Drive
Suite 1240
Arlington, VA 22209
USA
Telephone: 703-841-0652
Facsimile: 703-841-1597

Dr. Miriam Chavez

Investigador Titular C
Instituto Nacional de la Nutricion
Calle Vasco de Quiroga 15, Tlalpan
Mexico D.F. 14000
Mexico
Telephone: 525-573-1116
Facsimile: 525-573-1116
Facsimile 2: 525-655-1076

Dr. Henderson Chikhosi

Project Director
International Eye Foundation
PO Box 142
Nchalo
Malawi
Telephone: 265-426-298
Facsimile: 265-620-763
Facsimile 2: 301-986-1876 IEF/USA

Dr. Moses C. Chirambo

Eye Care Consultant
Sight Savers
PO Box 30858
Lilongwe 3
Malawi
Telephone: 265-721322
Facsimile: 265-721322
Facsimile 2: 265-721018
Telex: 11892 CAPHOT

Prof. Frank Chytil

Professor of Biochemistry
Vanderbilt University School of
Medicine

Department of Biochemistry
Nashville, TN 37232-0146
USA

Telephone: 615-322-4344

Facsimile: 615-322-4349

Facsimile 2: 615-343-0704

Dr. Nicholas Cohen

Expanded Programme on
Immunization

World Health Organization

Avenue Appia

1211 Geneva 27

Switzerland

Telephone: 41-22-791-2111

Facsimile: 41-22-791-0746

Telex: 415416 OMS

Dr. Nathan Congden

Dana Center

Johns Hopkins University

Wilmer Eye Institute 120

600 N. Wolfe Street

Baltimore, MD 21287-9019

USA

Telephone: 301-585-0702

Facsimile: 410-955-2542

Dr. James Cook

Phillips Professor of Medicine

University of Kansas Medical

Center

Division of Hematology

3901 Rainbow Boulevard

Kansas City, KS 66160-7233

USA

Telephone: 913-588-6077

Facsimile: 913-588-7031

Mrs. Anna Coutsoudis

Research Fellow

University of Natal Paediatrics and

Child Health

PO Box 17039

Congella 4013

South Africa

Telephone: 27-31-250-4405

Facsimile: 27-31-250-4388

Telex: 621231 SA

Dr. Filippo Curtale

Istituto Superiore de Sanita

Viale Regina Elena 299

Rome 00161

Italy

Facsimile: 39-6-466-0559

Ms. Diane Dalisera

Conference Coordinator

International Life Sciences

Institute

1126 Sixteenth Street, NW

Suite 300

Washington, DC 20036

USA

Telephone: 202-659-0074

Facsimile: 202-659-3859

Telex: 6814107 NUFOUND

Dr. Johannes Peter Damaseb

Medical Officer

Ministry of Health and Social

Services

Private Bag 2010

Khorikas 9000

Namibia

Telephone: 264-61-657-1264

Facsimile: 264-61-203-2334

Ms. Carolyn Darrehmane

IVACG Secretariat

The Nutrition Foundation, Inc.

1126 Sixteenth Street, NW

Suite 700

Washington, DC 20036

USA

Telephone: 202-659-9024

Facsimile: 202-659-3617

Telex: 6814107 NUFOUND

Dr. Frances R. Davidson

Deputy Director, Office of

Nutrition

Bureau for Research and

Development

Agency for International

Development

411, SA-18

Washington, DC 20523-1808

USA

Telephone: 703-875-4118

Facsimile: 703-875-7483

Dr. (Mrs.) Rajammal Devadas

Vice Chancellor

Avinashilingam Institute for Home

Science and Higher Education

for Women (Deemed University)

Coimbatore 641043

India

Telephone: 91-422-40140

Facsimile: 91-422-41786

Telex: 855 459 ADU IN

Dr. Michael J. Dibley

The Morvita Trial

Johns Hopkins University—

University of Gadjah Mada, PO

1236

Yogyakarta 55012

Indonesia

Telephone: 62-274-65076

Facsimile: 62-274-65076

Facsimile 2: 62-274-63388

Mr. Peter Dixon

Regional Director

Sight Savers

PO Box 34890

Nairobi

Kenya

Telephone: 254-2-503835

Mr. Cole Dodge

Regional Director

UNICEF ESARO

PO Box 44145

Nairobi

Kenya

Facsimile: 254-2-215-296

Facsimile 2: 254-2-215-584

Ms. Nicola Dollimore

Research Fellow, THEU

London School of Hygiene and

Tropical Medicine

Keppel Street

London WC1E 7HT

United Kingdom

Telephone: 44-71-927-2264

Facsimile: 44-71-436-4320

Facsimile 2: 44-71-436-5389

Telex: 8953474

Dr. William D. Drake

Community Systems Foundation

1130 Hill Street

Ann Arbor, MI 48104

USA

Telephone: 313-761-1357

Facsimile: 313-761-1356

Participants

Ms. Bongeka Dube

Agricultural Extension Specialist
Agricultural Technical &
Extension Services
Agritex, Box 1927
Bulawayo
Zimbabwe
Telephone: 263-9-67593
Facsimile: 263-9-77415

Ms. Sylva Etian

Technical Advisor for Child
Survival
CDC/USAID
USAID/Niamey
Washington, DC 20521-2420
USA
Telephone: 227-72-30-49
Facsimile: 227-72-39-18
Facsimile 2: 227-73-29-63
Telex: 5444 EMB NIA

Dr. U. Felix Ezepue

University of Nigeria Teaching
Hospital
PMB 01129
Enugu
Nigeria
Telephone: 234-42-330220

Dr. Peter Fajans

Assistant Professor, International
Health
University of Michigan
School of Public Health
9 Eastbury Ct.
Ann Arbor, MI 48105
USA
Telephone: 313-995-0048
Facsimile: 313-936-8199
Facsimile 2: 313-761-1356

Dr. Wafale Fawzi

Research Fellow
Harvard School of Public Health
Department of Nutrition
665 Huntington Avenue
Boston, MA 02115
USA
Telephone: 617-432-4655
Facsimile: 617-432-2435

Dr. Suzanne Filteau

Centre for International Child
Health
Institute of Child Health
30 Guilford Street
London WC1N 1EH
United Kingdom
Telephone: 44-71-242-9789 x2356
Facsimile: 44-71-404-2062

Dr. Claudia Fishman

Nutrition Communication Project
Academy for Educational
Development
1255 23rd Street, NW
Washington, DC 20037
USA
Telephone: 202-862-1990
Facsimile: 202-862-1947

Dr. Alix Fleury

Project Coordinator
Eye Care PROVAX
92, Ave. Christophe
Port-au-Prince
Haiti
Telephone: 509-45-8686
Facsimile: 509-45-8686

Dr. Rodolfo F. Florentino

Director
Food and Nutrition Research
Institute
Department of Science and
Technology
PO Box EA-467, Ermita, Pedro Gil
Street
Manila 1000
Philippines
Telephone: 632-59-51-13
Facsimile: 632-59-22-75

Dr. Luis Andres de Francisco

MCH-FP Project Director
International Centre for Diarrhoeal
Disease Research, Bangladesh
Community Health Division, GPO
Box 128
Dhaka 1000
Bangladesh
Telephone: 880-2-600171 x2230
Facsimile: 880-2-883116

Prof. Mamdouh K. Gabr

Professor of Pediatrics
Cairo University
162 Tahrir Street
Cairo
Egypt
Telephone: 20-2-393-0267
Facsimile: 20-2-393-0750
Facsimile 2: 20-2-574-0450

Mr. Moltshepi Galeemelwe

District Health Education
Nutrition Officer
c/o Family Health Division
Ministry of Health
PO Box 992
Gaborone
Botswana
Telephone: 267-353561
Facsimile: 267-302092
Facsimile 2: 267-353100

Mr. Sabu George

Research Associate
Cornell University
170 Uns Hall
South Asia Program
Ithaca, NY 14853
USA
Telephone: 607-256-3049
Facsimile: 607-255-1033

Dr. John Gmünder

Secretary
Task Force SIGHT AND LIFE
PO Box 2116
Basel CH-4002
Switzerland
Telephone: 41-61-691-2253
Facsimile: 41-61-688-1910
Facsimile 2: 41-61-691-9391

Ms. Carolina Godínez

Associate Program Officer
Program for Appropriate
Technology in Health (PATH)
1990 M Street, NW, Suite 700
Washington, DC 20036
USA
Telephone: 202-822-0033
Facsimile: 202-457-1466

Participants

Mr. James Greene

Principal Nutrition Specialist,
ASTPH
The World Bank
1818 H Street Room E-9071
Washington, DC 20433
USA
Telephone: 202-458-1245
Facsimile: 202-477-0357

Dr. Ted Greiner

Senior Lecturer/Nutrition
Consultant, SIDA
Uppsala University
International Child Health Unit
75185 Uppsala
Sweden
Telephone: 46-18-665-937
Facsimile: 46-18-515-380
Facsimile 2: 46-18-508-013
Telex: 8195007 ICH

Mrs. Shashi Prabha Gupta

Deputy Technical Advisor
Ministry of Food
54 New Campus, Hauz Khas
New Delhi 110 016
India
Telephone: 91-11-383823
Facsimile: 91-11-686-3402

Dr. Rainer Gutekunst

UNICEF/WHO Consultant
ICCID
Im Felde 10
W-2430 Neustadt
Germany
Telephone: 49-4561-7077
Facsimile: 49-4561-7078

Dr. Johnny Gyapong

Project Clinician
Ghana Vitamin A Supplementation
Trials
c/o MCEU, London School of
Hygiene and Tropical Medicine
Keppel Street
London WC1E 7HT
United Kingdom
Telephone: 44-71-927-2469
Facsimile: 44-71-436-4230

Dr. Hamam Hadi

Lecturer
Gadjah Mada University
Clinical Epidemiology and
Biostatistics
P.O. Box 1236
Yogyakarta 55012
Indonesia
Telephone: 62-274-63388
Facsimile: 62-274-63388/65076

Prof. Ya-shan Han

Professor of Food Chemistry
Beijing Agricultural University
Department of Food Science
Beijing 100094
China
Telephone: 86-1-258-2223
Facsimile: 86-1-258-2332
Telex: 222487 BAUCN

Dr. Suzanne S. Harris

Director, IVACG Secretariat
The Nutrition Foundation, Inc.
1126 Sixteenth Street, NW
Suite 700
Washington, DC 20036
USA
Telephone: 202-659-9024
Facsimile: 202-659-3617
Telex: 6814107 NUFOUND

Ms. Nancy Haselow

Deputy Director of Vitamin A
Programs
Helen Keller International
90 Washington Street
15th Floor
New York, NY 10006
USA
Telephone: 212-943-0890
Facsimile: 212-943-1220

Dr. M. Guillermo Herrera

Faculty Lecturer
Harvard School of Public Health
665 Huntington Avenue
Boston, MA 02115
USA
Telephone: 617-432-1341
Facsimile: 617-432-2435

Dr. Nimal Hettiaratchy

Nutrition Officer
UNICEF
11A Osborne Road, Ikopi
PO Box 1282
Lagos
Nigeria
Telephone 234-1-603540

Dr. Abraham Horwitz

Director Emeritus
Pan American Health Organization
525 Twenty-third Street, NW
Washington, DC 20037-2897
USA
Telephone: 202-861-3181
Facsimile: 202-223-5971

Ms. Ann E. Hudacek

Assessment Officer
World Food Program
c/o UN-World Food Program/
RLO—Sudan
PO Box 4482
Nairobi
Kenya
Telephone: 254-2-520787
Facsimile: 254-2-521161
Telex: 25693

Dr. Jean Humphrey

Assistant Professor
Dana Center for Preventive
Ophthalmology
Wilmer Eye Institute 120
Johns Hopkins University
600 N. Wolfe Street
Baltimore, MD 21287-9019
USA
Telephone: 410-955-1188
Facsimile: 410-955-2542

Ms. Man-Ming Hung

BP 46
Yaounde
Cameroon
Telephone: 237-21-13-20
Facsimile: 237-23-57-07

Ms. Laila Hussein

Professor, National Research
Center
Department of Nutrition
Giza, Dokki, El-Fahrir Street
Cairo
Egypt
Telephone: 202-701211 x4264
Facsimile: 202-700931
Telex: 94022 NAREC UN

Participants

Dr. Greg D. Hussey

Senior Specialist
Infectious Diseases Unit
Somerset Hospital
Dept. of Paediatrics & Child Health
University of Cape Town
Private Bag
Green Point 8051
South Africa
Telephone: 27-21-213311
Facsimile: 27-21-689-1287

Mr. Nael Islam

Helen Keller International/
Bangladesh
PO Box 6066 Gulshan
Dhaka 1212
Bangladesh
Telephone: 880-2-325628
Facsimile: 880-2-813310

Mr. Nazrul Islam

Country Director
Worldview—Bangladesh
House 76A, Road 12A
Dhanmondi RA
Dhaka-1209
Bangladesh
Telephone: 880-2-813504
Facsimile: 880-2-813138

Dr. Suraiya Ismail

Senior Lecturer
London School of Hygiene and
Tropical Medicine
Centre for Human Nutrition
2 Taviton Street
London WC1H 0BT
United Kingdom
Telephone: 44-71-380-0599
Facsimile: 44-71-383-5859
Facsimile 2: 44-71-336-5389
Telex: 8953471 LSITM

Mrs. Birgitta Jacks

Pharmacist, Nutritionist
SWEDRELIEF (UNICEF)
Runebergsgatan 6
S-114 29 Stockholm
Sweden
Telephone: 46-8-611-4579
Facsimile: 46-8-790-6610
Facsimile 2: 46-8-107453

Dr. Mohammad Jahangir

Director
Institute of Public Health Nutrition
(IPHIN)
R.C.C. 11, Sher-e-Bangla Nagar
Dhaka
Bangladesh
Telephone: 880-2-881361
Facsimile: 880-2-863510 UNICEF

Prof. Fehmida Jallil

Professor, Social and Preventive
Pediatrics
King Edward Medical College
76 Allaudin Road
Lahore Cantt
Pakistan
Telephone: 92-42-233509
Facsimile: 92-42-233509

Ambrosio Joaquim

Ministry of Health
Luanda
Angola
Telephone: 34-173

Dr. Manuel Romano Julien

Head of Department
Ministry of Health
Nutrition Section
Caixa Postal 203
Maputo
Mozambique
Telephone: 258-1-421738
Facsimile: 258-1-32103
Facsimile 2: 258-1-491679 UNICEF
Telex: 6-239

Dr. Iqbal Kabir

Programme Officer, Health and
Nutrition
UNICEF - Dhaka
PO Box 58
Dhaka 1000
Bangladesh
Telephone: 880-2-500181/6
Facsimile: 880-2-863678
Telex: 642471 CEF BJ

Dr. E.M. Kafwembe

Senior Scientific Officer
Tropical Diseases Research Centre
(TDRC)
PO Box 71769
Ndola
Zambia
Telephone: 610961/4 ext.228
Facsimile: 260-2-614487
Facsimile 2: 260-2-612837
Telex: 30180 ZA

Dr. Samuel G. Kahn

Senior Nutrition Advisor
Office of Nutrition
Bureau for Research and
Development
Agency for International
Development
411, SA-18
Washington, DC 20523-1808
USA
Telephone: 703-875-4228
Facsimile: 703-875-7483

Dr. Medi Kawuma

Senior Lecturer and Head
Makerere University
Ophthalmology Department
PO Box 7072
Kampala
Uganda
Telephone: 256-43-530881
Facsimile: 256-43-22050
Facsimile 2: 256-43-20982

Dr. Eileen Kennedy

International Food Policy
Research Institute
1200 17th Street, NW
Washington, DC 20036
USA
Telephone: 202-862-8180
Facsimile: 202-167-4439

Mr. Joseph Kesa

OVP and Ministry of Planning and
National Development
Nairobi
Kenya

Dr. Subarna Khattry

Director
Nepal Nutrition Intervention
Project -Sarlahi (NNIPS)
c/o Nepal Netra Jyoti Sangh, PO
Box 335
Kathmandu
Nepal
Telephone: 977-1-212-102
Facsimile: 977-1-227-505

Prof. Ha Huy Khoi

Vice Director
National Institute of Nutrition
48 Tang Bat Ho
Hanoi
Vietnam
Telephone: 84-4-57090/53784
Facsimile: 84-4-254679

Participants

Dr. Chris Kjolhede

The Johns Hopkins University
School of Hygiene and Public
Health

Department of International
Health

615 N. Wolfe Street
Baltimore, MD 21205-5478
USA

Telephone: 410-955-2786
Facsimile: 410-955-0196

Mr. Rolf Klemm

Country Director
Helen Keller International
2139 Fidel A. Reyes Street
Malate

Manila
Philippines
Telephone: 632-501-526
Facsimile: 632-501-526
Facsimile 2: 632-521-2378

Dr. Benny Kodyat

Director, Nutrition Directorate of
MOH

Helen Keller International
PO Box 4338

Jakarta
Indonesia
Telephone: 62-21-520-7297
Facsimile: 62-21-520-7297

Dr. Michael C. Latham

Director, Program in International
Nutrition

Cornell University
Department of Nutritional
Sciences

Savage Hall
Ithaca, NY 14853-6301
USA

Telephone: 607-255-3041
Facsimile: 607-255-1033
Telex: WU16713054

Ms. Kirsten Laursen

Deputy Director of Training
Helen Keller International
90 Washington Street
15th Floor

New York, NY 10006
Telephone: 212-943-0890
Facsimile: 212-943-1220

Dr. Aaron Lechtig

Regional Nutrition Advisor
Eastern and Southern Regional
Office

UNICEF
PO Box 44145
Nairobi
Kenya

Telephone: 254-2-215296
Facsimile: 254-2-215584

Mr. Steven Lecierq

Research Associate
Johns Hopkins University
c/o NNIPS, Nepal Netra Jyoti
Sangh

PO Box 335
Kathmandu
Nepal
Telephone: 977-1-212-102
Facsimile: 977-1-227-505

Prof. B.S. Lindblad

Professor and Chairman
The Aga Khan University
Department of Paediatrics
Stadium Road, PO Box 3500
Karachi 74800

Pakistan
Telephone: 92-21-493-0051
Facsimile: 92-21-493-1294

Prof. Ishrat Lindblad

c/o Prof. B.S. Lindblad
Aga Khan University
Department of Paediatrics
Stadium Road, PO Box 3500
Karachi 74800

Ms. Mary Linehan

Assistant Director
VITAL
1616 N. Fort Myer Drive
Suite 1240

Arlington, VA 22209
USA
Telephone: 703-841-0652
Facsimile: 703-841-1597

Dr. Tetevi Logovi

Country Director
Helen Keller International/Burkina
Faso

c/o Dr. Siaka Diarra, President,
ABPAM

01 BP 5588/5658
Ouagadougou 01
Burkina Faso
Telephone: 226-31-45-17
Facsimile: 226-30-67-67

Mr. Allen K. Luneta

Deputy Executive Director
National Food and Nutrition
Commission

Box 32669
Lusaka
Zambia
Telephone: 260-1-227803

Dr. D.K.W. Lwamafa

ADMS/Nutrition
Ministry of Health
PO Box 8
Entebbe
Uganda
Telephone: 256-42-20200

Dr. Dilip Mahalanabis

Associate Director In Charge
International Centre for Diarrhoeal
Disease Research, Bangladesh
Clinical Sciences Division
GPO Box 128

Dhaka 1000
Bangladesh
Telephone: 880-2-601519
Facsimile: 880-2-883116
Telex: 675612 ICDD BJ

Dr. Ahmed Makki

Undersecretary for Health Services
Ministry of Public Health
UNICEF/Sana'a

Sana'a
Republic of Yemen
Telephone: 967-1-231256/8
Facsimile: 967-1-251613
Telex: 2461

Participants

Mrs. Lucie Malaba
 Nutritional Biochemistry
 Researcher
 University of Zimbabwe
 PO Box MP167
 Mount Pleasant
 Harare
 Zimbabwe

Telephone: 263-4-303211
 Facsimile: 263-4-732828

Dr. Mohamed Mansour
 Nutrition Advisor
 c/o VITAL
 1616 N. Fort Myer Drive
 Suite 1240
 Arlington, VA 22209
 USA

Telephone: 703-811-0652
 Facsimile: 703-862-1597

Mrs. Nancy Martelly
 Ophthalmologist
 Eye Care—Haiti
 92 Avenue Christophe
 Port au Prince
 Haiti

Telephone: 509-45-8686
 Facsimile: 509-45-8686
 Facsimile 2: 509-57-3012

Ms. Segametsi Maruapula
 Nutritionist, Food and Nutrition
 Unit

Ministry of Health
 Family Health Division
 PO Box 992
 Gaborone
 Botswana

Telephone: 267-353561
 Facsimile: 267-302992
 Facsimile 2: 267-353100

Dr. John B. Mason

Technical Secretary
 ACC/SCN
 c/o World Health Organization
 20 Avenue Appia
 CH-1211 Geneva 27
 Switzerland

Telephone: 41-22-791-0456
 Facsimile: 41-22-791-0746

Ms. Joyce B.K. Meme
 Kenya Food and Nutrition
 Network

PO Box 47639
 Nairobi
 Kenya
 Telephone: 254-2-792953

Dr. Hugo R. Mendoza
 CENISMI

Hospital de Ninos, Rm. 424
 Robert Reid Cabral
 Ave. Lincoln 2
 Santo Domingo
 Dominican Republic
 Telephone: 809-533-5373
 Facsimile: 809-532-5872

Mr. Dwayne Milbrand

IVACG Secretariat
 The Nutrition Foundation, Inc.
 1126 Sixteenth Street, NW
 Suite 700
 Washington, DC 20036
 USA

Telephone: 202-659-9024
 Facsimile: 202-659-3617
 Telex: 6814107 NUTOUND

Dr. Kamal Ahmed Mohammed

Director, Nutrition Department
 Ministry of Public Health
 PO Box 303
 Khartoum
 Sudan

Mr. Saul Morris

Statistician, MCEU
 Dept. of Epidemiology and
 Population Science
 London School of Hygiene and
 Tropical Medicine
 Keppel Street
 London WC1E 7HT
 United Kingdom

Telephone: 44-71-927-2422
 Facsimile: 44-71-436-4230
 Facsimile 2: 44-71-436-5389
 Telex: 8953474 LSHTML G

Dr. Muhllal

Director, Nutritional Biochemistry
 Lab
 Nutrition Research and
 Development Center
 Ministry of Health
 Komplek Gizi, Jalan Semboja
 Bogor
 Indonesia

Telephone: 62-251-31374
 Facsimile: 62-251-317794
 Facsimile 2: 62-251-326348

Dr. D.L. Musonge

CDDARI Programme Manager
 Ministry of Health
 PO Box 8
 Entebbe

Uganda
 Telephone: 256-42-20417
 Telephone 2 (home): 256-41-543324
 Facsimile: 256-42-20047

Mrs. Dilly Kayuba Mwale

Ministry of Health
 Box 30205
 Lusaka
 Zambia

Dr. Mathurin C. Nago

Vice-Dean, Faculty of Agricultural
 Sciences
 National University of Benin
 BP 526
 Cotonou
 Benin

Telephone: 22-9-331940
 Facsimile: 22-9-313559

Mrs. Thokozile Ncube

Senior Nutritionist
 Ministry of Health
 PMD Matabeleland North
 PO Box 411
 Bulawayo
 Zimbabwe

Telephone: 263-9-62914
 Facsimile: 263-9-77915

Mr. Aphrodís Ndaglylmfura

Head, Micronutrients Programme
 Ministry of Health
 c/o UNICEF-Kigali
 Rue de l'Akagera, BP 381
 Kigali
 Rwanda

Telephone: 250-74866
 Facsimile: 250-84715 UNICEF

Participants

Dr. Chelkh Ndiaye
Regional Food and Nutrition
Officer
Food and Agriculture Organization
Ave. A.G. Nasser and Liberia Road
PO Box 1628
Accra
Ghana
Telephone: 233-21-666851
Facsimile: 233-21-666-8427
Facsimile 2: 233-21-773116

Dr. Jean Michel Ndiaye
Health Project Officer
UNICEF
BP 3420
Ouagadougou
Burkina Faso
Telephone: 226-300966
Facsimile: 266-300968

Dr. David Nelson
Nutrition Advisor
VITAL
1616 N. Fort Myer Drive
Suite 1240
Arlington, VA 22209
USA
Telephone: 703-841-0652
Facsimile: 703-841-1597

Dr. Penny Nestel
Consultant
VITAL
1616 N. Fort Myer Drive
Suite 1240
Arlington, VA 22209
USA
Telephone: 703-841-0652
Facsimile: 703-841-1597

Prof. Vicky Newman
Perinatal Nutritionist
Wellstart International
4062 First Avenue
San Diego, CA 92103
USA
Telephone: 619-574-8158
Facsimile: 619-294-7787
Facsimile 2: 619-574-8159

Dr. Duncan Ngare
Project Director
Vitamin A Kenya Project
International Food Policy
Research Institute
PO Box 20811
Nairobi
Kenya
Telephone: 254-2-718444
Facsimile: 254-2-718444

Dr. Tu Ngu
National Institute of Nutrition
48 Tang Bat Ho
Hanoi
Vietnam
Telephone: 84-4-57090
Facsimile: 84-4-254679

Prof. Norman Z. Nyazema
Department of Clinical
Pharmacology
University of Zimbabwe Medical
School
PO Box A-178
Avondale
Harare
Zimbabwe
Telephone: 263-4-791631
Facsimile: 263-4-732828
Telex: 26580 UNIVZ ZW

Prof. James Allen Olson
Distinguished Professor
Iowa State University
Biochemistry and Biophysics
3252 Molecular Biology Building
Ames, IA 50011
USA
Telephone: 515-294-3068
Facsimile: 515-294-4141
Facsimile 2: 515-294-0453
Telex: 283359 IASU UR

Dr. Stella O. Omojokun
Head, Nutrition Section
Federal Ministry of Health and
Social Services
8 Harvey Road, Yaba
Lagos
Nigeria

Mr. Tom Ortiz
Director of Operations
Task Force for Child Survival &
Development
The Carter Center
One Copenhill
Atlanta, GA 30307
USA
Telephone: 404-872-4122
Facsimile: 404-872-9661

Ms. Anne Palmer
Somavita Project Manager
Helen Keller International
Bina Mulia Bldg.—9th Floor, PO
4338
Jl. H.R. Rasuna Said, Kav. 10
Kuningan
Jakarta 1295
Indonesia
Telephone: 62-21-520-7297
Facsimile: 62-21-520-7297

Dr. Chet Raj Pant
Nepal Netra Jyoti Sangh
Vitamin A Child Survival Project
PO Box 335, Tripureshwor
Kathmandu
Nepal
Telephone: 977-1-472-376
Facsimile: 977-1-223-999
Facsimile 2: 977-1-227-505

Dr. Adeline Patterson
Director
Caribbean Food and Nutrition
Institute
PO Box 140, Mona
Kingston 7
Jamaica
Telephone: 809-927-1540
Facsimile: 809-927-2657

Ms. Saskia de Pee
Department of Human Nutrition
Wageningen Agricultural
University
PO Box 8129
6700 EV Wageningen
The Netherlands
Telephone: 31-8370-82589
Facsimile: 31-8370-83342
Facsimile 2: 31-8370-84762

Participants

Dr. Magnus Pfahl

Senior Staff Scientist
La Jolla Cancer Research
Foundation
10901 N. Torrey Pines Road
La Jolla, CA 92037
USA
Telephone: 619-455-6480
Facsimile: 619-453-6217
Facsimile 2: 619-455-0181

Mr. Robert Pratt

Project Director
VITAL
1616 N. Fort Myer Drive
Suite 1240
Arlington, VA 22209
USA
Telephone: 703-841-0652
Facsimile: 703-841-1597

Dr. Pawlos Quana'a

IVACG Regional Representative
for Africa
International Eye Foundation
Addis Ababa University
PO Box 1417
Addis Ababa
Ethiopia
Telephone: 251-1-150543
Facsimile: 251-1-550911
Telex: 21576 FOMAA ET

Ms. Kate Quist

Human Resource Development
Nutrition Division
Ministry of Health
PO Box N-78
Accra
Ghana
Facsimile: 233-21-774338

Ms. Anne Ralfe

Director of Vitamin A Programs
Helen Keller International
90 Washington Street
15th Floor
New York, NY 10006
USA
Telephone: 212-943-0890
Facsimile: 212-943-1220

Dr. Usha Ramakrishnan

74, Presidential Apts.
Amherst, MA 01002
USA
Telephone: 413-549-0035
Facsimile: 607-255-1033

Dr. Vinodini Reddy

Director
National Institute of Nutrition
PO Jamai Osmania
Hyderabad, A.P. 500 007
India
Telephone: 91-842-868-083
Facsimile: 91-842-868-083
Facsimile 2: 91-842-869-074

Dr. Serge Resnikoff

Director
Institute of African Tropical
Ophthalmology (I.O.T.A.)
BP 248
Bamako
Mali
Telephone: 223-223421
Facsimile: 223-225186
Facsimile 2: 33-1-4556-0740

Ms. Liliana Riva Clement

Vitamin A Laboratory Technician
Johns Hopkins University
Dana Center for Preventive
Ophthalmology
Wilmer Eye Institute 120
600 N. Wolfe Street
Baltimore, MD 21210
USA
Telephone: 410-955-1637
Facsimile: 410-955-2542

Dr. David Ross

Senior Lecturer in Epidemiology
London School of Hygiene and
Tropical Medicine
Dept. of Epidemiology and
Population
Keppel Street
London WC1E 7HT
United Kingdom
Telephone: 44-71-927-2603
Facsimile: 44-71-436-4230
Facsimile 2: 44-71-436-5389

Mrs. Eugenia Saenz de Tejada

Coordinator, Unidad Pro-Vita-A
International Eye Foundation
Hospital Rodolfo Robles
Diagonal 21 y 19 Calle, Zona 11
Guatemala 01011
Guatemala
Telephone: 502-2-730953
Facsimile: 502-2-733906
Facsimile 2: 301-986-1876 IEF/USA

Mrs. Else Sanogo-Glenthøj

Country Director
Helen Keller International/Niger
BP 11728
Niamey
Niger
Telephone: 227-73-50-26
Facsimile: 227-73-29-63

Dr. Leonor Maria P. Santos

London School of Hygiene &
Tropical Medicine
Epidemiology and Population
Sciences
Keppel Street
London WC1E 7HT
United Kingdom
Telephone: 44-71-636-8636
Facsimile: 44-71-436-4230

Dr. Joseph A. Sciafani

Associate Executive Director
Helen Keller International
90 Washington Street
15th Floor
New York, NY 10006
USA
Telephone: 212-943-0890
Facsimile: 212-943-1220

Dr. Hassan Segulle

Project Officer for Health and
Nutrition
UNICEF Sana'a
3 United Nations Plaza
New York, NY 10017
USA
Telephone: 967-1-231256/7
Facsimile: 967-1-251613
Telex: 895 2461

Dr. Richard Semba

Assistant Professor
Dana Center for Preventive
Ophthalmology
Wilmer Eye Institute, Room 120
Johns Hopkins Hospital
600 N. Wolfe Street
Baltimore, MD 21205
USA
Telephone: 410-955-3572
Facsimile: 410-955-1322

Participants

Dr. Mahendra Sheth

Chief, Health Section
UNICEF Khartoum
PO Box 1358
Khartoum
Sudan
Telephone: 249-11-46384
Facsimile: 873-161-0442
Telex: 0984-24105 SCO SD

Ella Shihepo

Private Bag 13198
Windhoek
Namibia
Facsimile: 264-61-203-2334

Dr. Paulinus L.N. Sikosana

Provincial Medical Director
Ministry of Health and Child
Services
PMD Matabeleland North, PO Box
441

Bulawayo
Zimbabwe
Telephone: 263-9-68976
Facsimile: 263-9-77915

Dr. Franz Simmersbach

Officer-in-Charge, Nutrition
Programmes
Food Policy and Nutrition Division
Food and Agriculture Organization
of the United Nations
Via delle Terme di Caracalla
Rome 00100

Italy
Telephone: 396-5797-3014
Facsimile: 396-5797-3152
Facsimile 2: 396-5797-5155

Dr. Nancy L. Sloan

Consultant, Helen Keller
International
The Population Council
Program Council, 44th floor
1 Dag Hammarskjöld Plaza
New York, NY 10017
USA
Telephone: 212-339-0601
Facsimile: 212-755-6052

Ms. Suttalak Smitasiri

Nutrition Program
University of Queensland
Clinical Sciences Building
Royal Brisbane Hospital, Herston
Queensland 4029
Australia
Telephone: 61-7-365-5400
Facsimile: 61-7-257-1253

Dr. Noel W. Solomons

Scientific Coordinator & Senior
Scientist
CeSSIAM
Hospital de Ojos y Oidos
Diagonal 21 y 19 Calle, Zona 11
Guatemala City 01011
Guatemala
Telephone: 502-2-730-375
Facsimile: 502-2-733-906

Dr. Florentino S. Solon

Executive Director
Nutrition Center of the Philippines
MC PO Box 653, Makati
Metro Manila
Philippines
Telephone: 63-2-818-99-86
Facsimile: 63-2-818-74-03

Dr. Alfred Sommer

Dean
Johns Hopkins University
School of Hygiene and Public
Health
615 N. Wolfe Street
Baltimore, MD 21205-2179
USA
Telephone: 410-955-3510
Facsimile: 410-955-0121

Dr. Anne Sowell

Research Chemist
Centers for Disease Control
MS-F18, 1770 Buford Highway, NE
Atlanta, GA 30341-3724
USA
Telephone: 404-488-4426
Facsimile: 404-488-4609

Mrs. Th. Ninuk Sri Hartini

Lecturer
Gadjah Mada University
Clinical Epidemiology and
Biostatistics
PO Box 1236
Yogyakarta 55281
Indonesia
Telephone: 62-274-63388
Facsimile: 62-274-63388
Facsimile 2: 62-274-65076

Mrs. Louise Sserunjogi

Nutritionist
Makerere University
Child Health and Development
Centre
PO Box 7072
Kampala
Uganda
Telephone: 256-541684
Facsimile: 256-531350

Dr. Rebecca J. Stoltzfus

Assistant Professor
The Johns Hopkins University
School of Hygiene and Public
Health
Division of Human Nutrition
615 N. Wolfe Street
Baltimore, MD 21205
USA
Telephone: 410-955-2786
Facsimile: 410-955-0196

Mr. Timothy Stone

Consultant
CIDA
200 Promenade du Portage
Hull K1G 0G4
Canada
Telephone: 613-730-1709

Dr. G. Subbulakshmi

Professor and Head
SNDT's Women's University
Juha Road
Bombay 400049
India

Participants

Dr. Augustinus Sutanto

Principal Investigator CSP-2
Project
Provincial Health Office NTB
Jln. Kesehatan I/1
Mataram, Lombok, NTB
Indonesia
Telephone: 62-364-22931
Facsimile: 62-364-21055
Facsimile 2: 62-364-27513

Dr. A.K. Tabibul

Helen Keller International
PO Box 6066 Gulshan
Dhaka 1212
Bangladesh
Telephone: 880-2-325628
Facsimile: 880-2-813310
Telex: 642940 ADAB B1

Mrs. Julia Tagwireyi

Director of Nutrition
Ministry of Health
Kaguvu Building, Central Avenue
PO Box 8201, Causeway
Harare
Zimbabwe

Telephone: 263-4-792454
Facsimile: 263-4-791169
Facsimile 2: 263-4-793634

Mr. Aminuzzaman Talukder

Helen Keller International
PO Box 6066 Gulshan
Dhaka 1212
Bangladesh
Telephone: 880-2-325628
Facsimile: 880-2-813310

Mrs. Sherry A. Tanumihardjo

Assistant Scientist
Iowa State University
3258 Molecular Biology Building
Ames, IA 50011
USA

Telephone: 515-294-2646/3068
Facsimile: 515-294-4141
Facsimile 2: 515-294-0453

Dr. Ignatius Tarwotjo

Ministry of Health
Jl. Hang Jabat IV No. 2, Rt. 004/004
Kebayoran Baru
Jakarta Selatan 12120
Indonesia
Telephone: 62-21-720-8416
Facsimile: 62-21-520-7297 11K1

Dr. Robert L. Tilden

Lecturer
University of Michigan
School of Public Health
109 Observatory Hill
Ann Arbor, MI 48109
USA

Telephone: 313-763-5566
Facsimile: 313-936-8199
Facsimile 2: 313-429-2735

Dr. Alberto Torres

Medical Officer
CDR/World Health Organization
Avenue Appia
Geneva 27
Switzerland
Telephone: 41-22-791-2641

Mr. Ronald Toussaint

Save the Children
PO Box 407139
25, Rue Babiole
Ft. Lauderdale, FL 33340
USA

Telephone: 509-453-795
Facsimile: 509-450-036

Dr. Frederick L. Trowbridge

Director, Division of Nutrition
National Center for Chronic
Disease Prevention and Health
Promotion (CDC)
4770 Buford Highway
Mail Stop K-24
Atlanta, GA 30341
USA

Telephone: 404-488-4721
Facsimile: 404-488-4479

Ms. Charito S. Tuason

Monitoring and Evaluation Officer
Helen Keller International/
Philippines
2139 Fidel A. Reyes Street
Malate
Manila
Philippines

Telephone: 632-501-526
Facsimile: 632-501-526
Facsimile 2: 632-521-2378

Dr. Barbara A. Underwood

World Health Organization
Nutrition Unit
Avenue Appia
CH-1211 Geneva 27
Switzerland
Telephone: 41-22-791-4146
Facsimile: 41-22-791-0746

Prof. Aree Valyasevi

Dean
Faculty of Medicine
Thammasat University
Rangsit Campus Klong-Luang
Prathum Thane 12120
Thailand
Telephone: 66-2-516-9890
Facsimile: 66-2-516-9403

Ms. Margot Van der Velden

Agriculture University/TFNC
Heideweg 4
5175 PP LOON op 2 AND
The Netherlands
Telephone: 04166-2331

Dr. Anna Verster

Regional Advisor on Nutrition
World Health Organization
Eastern Mediterranean Regional
Office

PO Box 1517
Alexandria 21511
Egypt
Telephone: 203-483-0090
Facsimile: 203-483-8916
Telex: 54028 WHO UN

Dr. Shella Vir

Project Officer, Nutrition
UNICEF
73, Lodi Estate
New Delhi
India

Prof. Fernando E. Viteri

ISTNA/CNAM
2 Rue Conte
Paris F-75003
France
Telephone: 33-1-4027-2473
Facsimile: 33-1-4027-0153

Dr. Tomas Walter

Head, Hematology Unit
INTA, University of Chile
Casilla 138-11
Macul
Santiago 55-10
Chile
Telephone: 562-221-5962
Facsimile: 562-221-4030

Ms. Ruth Wamatuba

Ministry of Health
PO Box 43319
Nairobi
Kenya
Telephone: 254-2-725105

Dr. Clive E. West

Associate Professor
Wageningen Agricultural
University
Department of Human Nutrition
PO Box 8129
6700 EV Wageningen
The Netherlands
Telephone: 31-8370-82589
Facsimile: 31-8370-83342
Facsimile 2: 31-8370-84762
Telex: 45015 BLOWG NL

Dr. Keith P. West

Associate Professor
Dana Center for Preventive
Ophthalmology
Johns Hopkins University
Wilmer Eye Institute 120
600 N. Wolfe Street
Baltimore, MD 21287-9019
USA
Telephone: 410-955-2061
Facsimile: 410-955-2542

Mr. Steven Wilbur

Country Director
Helen Keller International/
Indonesia
PO Box 4338
Jakarta
Indonesia
Telephone: 62-21-516-364
Facsimile: 62-21-520-7297

Ms. Alexandra Yuster

UNICEF New Delhi
73, Lodi Estate
New Delhi 110003
India
Telephone: 91-11-690-401
Facsimile: 91-11-462-7521

XV IVACG Meeting