

Innocenti Micronutrient Research Report #1

Rapporteur: Dr. Alfred Sommer,
Chair, International Vitamin A Consultative Group (IVACG) Steering Committee

Micronutrient deficiencies represent a major, “hidden” form of malnutrition that affects hundreds of millions of young children and women in the developing world. The ability of research in recent decades to reveal the health and survival impact of several individual deficiencies, notably those of vitamin A, zinc, iodine and iron, and to influence prevention policy has stimulated a rising tide of research addressing the public health impact of preventing both single and multiple micronutrient deficiencies during early childhood and among women during pregnancy and lactation. This first meeting on micronutrients and health, held at the UNICEF Innocenti Research Center on April 17–20, 2005, was organized under the auspices of WHO/UNICEF/IVACG, with financial assistance from the Office of Health, Infectious Diseases and Nutrition, Global Health Bureau, US Agency for International Development (USAID). The conference enabled scientists active in micronutrient health research to identify a limited set of emerging issues related to both the efficacy and safety of micronutrient supplementation that bear upon health and nutrition policies and require relatively urgent clarification through new, strategically conducted research. It is anticipated that future meetings will explore other timely issues relevant to the emerging agenda of nutrient-nutrient and nutrient-disease interactions as they relate to improving the health of disadvantaged populations.

The aim of the conference was not to provide a formal analysis or an exhaustive review of all available data, but rather to put together a thoughtful distillation of recently completed studies and those in progress analyzed against the backdrop of existing policies, beliefs, and collective sources of potential inconsistencies. The overarching goal was to bring clarity and focus to the research agenda of greatest programmatic priority.

Available evidence was graded on a three-point scale representing the adequacy of the evidence for reaching definitive conclusions and, separately, the urgency and health policy relevance for additional data (where additional data were needed). Definitive data (or high urgency and relevance of new information) were graded “A”; strongly suggestive data, particularly if critical to major health policies, were graded “B”; interesting, but still tentative data, or data not of immediate health relevance, were graded “C.” Therefore, the most urgent research needs are items rated B: high potential relevance still requiring further confirmation or elucidation.

Three issues dominated the discussion:

1. The health consequences of deficiency/supplementation of individual micronutrients, principally vitamin A, zinc, and iron.
2. The health impact of simultaneous supplementation with varying combinations and dosages of multiple micronutrients (including but not limited to the three listed above).
3. The relevance of population characteristics (co-morbidities with HIV and malaria, baseline micronutrient status, anthropometric indices, and other

nutritional/health/ethnic/cultural factors) on the questions raised in numbers 1 and 2 above.

I. Supplementation* with a Single Micronutrient to Improve the Health of Newborns, Infants, Young Children, and their Mothers

A. Vitamin A Supplements for Preschool-age Children

1. *Vitamin A Supplements As Community-Wide Prophylaxis among Children 6 Months through 5 Years of Age, Including Use As Acute Treatment for Severe Measles, to Reduce Childhood Morbidity and Mortality*

Level A Evidence for Benefit: Definitive evidence of effectiveness and safety has been provided by many randomized, controlled clinical trials. More recent studies in HIV-positive children have demonstrated that even within this group there is a reduction or delay in AIDS-related signs and symptoms, prolongation of survival, and no evidence of harmful effects.

2. *Administration of High-dose Vitamin A within the First 2 Days of Life to Children of HIV-negative Mothers*

Level A-B Evidence for Benefit: Strong evidence for benefit in vitamin A-deficient populations in southern Asia is available from both a randomized, hospital-based trial in Indonesia and a recent community-based trial in southern India among presumably HIV-negative women living in areas of very low HIV prevalence. Both studies show substantial reductions in neonatal mortality during the first 4 months of life (64% and 22%, respectively). In one of these two studies, the greatest benefit was in children weighing over 2500 g; in the other, it was in those weighing under 2500 g.

A very recent hospital-based trial of births to HIV-negative women in an otherwise well-nourished and vitamin A-sufficient urban population in Africa (Harare, Zimbabwe) failed to detect either benefit or harm to the treatment group.

Urgent Research Agenda (Level A): One additional study in a traditional south Asian population in which vitamin A deficiency is endemic and neonatal/early childhood mortality is high would bolster level A evidence for Asia and is already under way in Bangladesh. It is particularly important that similar studies be launched in traditionally rural African sites, where vitamin A deficiency is prevalent and childhood mortality is high. Preferably, these sites should vary in their degree of prevalent co-morbidities (e.g., endemic malaria, HIV) to determine the relevance of this intervention within these varied settings in Africa, particularly in the presence of other important childhood causes of morbidity and mortality. If possible, these studies should include provisions for delineating the pathophysiologic/molecular mechanism(s) that might account for this apparent benefit, including

* “Supplementation” is used in the generic sense: increasing the intake of the micronutrient through tablets, capsules, or fortified dietary items.

alterations in the immune response of young infants and any variability in response that might be related to preterm versus full-term delivery among low-birth-weight infants.

The first 4 months of life is a critical age at which to provide benefit if possible, since it is the age at which children suffer the highest mortality. It therefore represents an opportunity for dramatically reducing the absolute numbers of childhood deaths and for improving overall infant (and child) survival.

3. *Vitamin A Supplementation of Children 2 Weeks through 4 Months of Age*

Level A Evidence for No Benefit: Available evidence indicates that supplementation during this period is safe but probably not efficacious (at the levels and dosing schedules now used). No evidence of any reduction in morbidity or mortality has been shown in any study to date, including NNIPS-1 and multicountry WHO studies, where vitamin A supplementation was linked to EPI (Expanded Programme on Immunization) visits; note that WHO trials do not fully replicate the IVACG-EPI vitamin A recommendations for later infancy. It is equally clear, however, that children were not harmed by these supplements, and a mild-to-modest improvement in vitamin A status by EPI-linked supplements administered at 6, 10, and 14 weeks of age was still evident at 6 months of age.

4. *Vitamin A Supplementation (200,000 IU or 400,000 IU in Split Doses) to HIV-negative Mothers within the First 6 Weeks Postpartum*

Level A Evidence of Lack of Benefit to the Child (Possibly Some Benefit to the Mother): Few, if any, studies (including WHO studies combining maternal postpartum supplementation with EPI-linked infant supplementation in I.A.3. above) have shown any significant benefit in infant outcomes.

Urgent Research (Level A): It is important to quantify the impact of postpartum supplementation of mothers on their own vitamin A status and health.

Many mothers are themselves vitamin A deficient and show clinically significant evidence of deficiency pre- and postpartum. Routine postpartum supplementation could play an important role in reducing maternal morbidity and mortality, and is therefore an area that urgently needs further investigation. Preliminary evidence from a single study of women living in a high-HIV-risk environment suggests another potential benefit as well: a small subsample of HIV-negative Zimbabwean women with known low serum retinol who received vitamin A had a reduction in postpartum acquisition of HIV infection. There is ample evidence (level A) that women who are themselves significantly deficient have the worst pregnancy outcomes and that small, frequent supplements of vitamin A are better absorbed and utilized than larger, less frequent ones. There is therefore reason to suspect that both the vitamin A status and the health outcomes of both the mother

and the infant might benefit from alternative strategies providing supplemental vitamin A to the mother, which needs to be tested:

- Frequent (daily or weekly) vitamin A (RDA-equivalent) supplementation of women for months, beginning preconceptionally (and perhaps extending throughout their reproductive years), to improve vitamin A status of mother, newborn, and infant at the time of delivery and during the early postpartum periods.
- Frequent (RDA-equivalent) vitamin A supplementation targeted to postpartum, breastfeeding women to improve their vitamin A status and health and that of their infants.

Given the preliminary but encouraging evidence that improving the vitamin A status of HIV-negative, vitamin A-deficient women might reduce their risk of HIV acquisition in high-risk environments, it is important that the remaining 90% of sera from the relevant Zimbabwe study population be analyzed for baseline vitamin A status and the potential impact of vitamin A supplementation in this deficient subgroup. Should these results remain positive (and reach statistical significance), relevant replication trials in multiple populations at risk for HIV infection should be launched. An effective means of reducing the risk of subsequent HIV infection through simple vitamin A supplementation would override, on a community prophylaxis basis, all other issues related to postpartum maternal supplementation with high-dose vitamin A in populations in which vitamin A deficiency is widespread and HIV is endemic.

5. *Daily Vitamin A Supplementation with or without Postpartum Large Doses (200,000 IU or 400,000 IU in Split Doses) to HIV-Positive Mothers within the First 6 Weeks Postpartum to Reduce Vertical Transmission of HIV*

Level A Evidence for Lack of Benefit: Available evidence indicates that vitamin A supplementation does not reduce vertical, or mother-to-child transmission (MTCT), of HIV.

Level A-B Evidence for No Risk: Available evidence indicates that vitamin A does not increase MTCT of HIV. Three of four studies (South Africa, Malawi, Zimbabwe), showed no increase in MTCT. One study from Dar Es Salaam (urban Tanzania) employed vitamin A and very large doses of beta-carotene: 30 mg daily, or six times the normal recommendation, the same very high dose that increased cancer incidence in the CARET (Carotene and Retinol Efficacy Trial) study. These doses were administered longer than in any other study (20 weeks prepartum through lactation) and were associated with an apparent increase in MTCT.

It remains uncertain whether the seemingly anomalous results from Tanzania were real or chance, and if real, what the reason for this was (e.g., the unusually large dose of beta-carotene, which has the capacity to activate non-RAR genes/metabolic pathways; the duration of administration; or some other, unrecognized characteristic of the study subjects or methods). Furthermore, among children born seemingly HIV negative to HIV-positive

mothers dosed with vitamin A in the Zimbabwe study, who may have been exposed to HIV shortly thereafter, there was a small but potentially real increase in the risk of infection.

In the absence of any compelling benefit of administering vitamin A to HIV-positive pregnant or lactating women, there seems to be little rationale to justify such supplementation, except as a treatment for xerophthalmia. This may become a challenging issue if the antenatal vitamin A supplementation trials presently under way in Bangladesh and Ghana confirm that antenatal vitamin A supplementation reduces pregnancy-related maternal mortality, as seen in NNIPS-2 among HIV-negative women (see I.B.1, I.B.2, and I.B.3 below). In that case, it will become necessary to either target antenatal vitamin A intervention to HIV-negative women or to confirm that there is no deleterious effect from small-dose (RDA equivalent) vitamin A antenatal supplementation (as suggested by three of the four major studies on MTCT). It is also critical to consider at some future time (see section B below), the potential value of daily maternal multiple micronutrient supplements for community-wide use, as presently practiced in most market economies, all of which routinely contain vitamin A (as tablets, capsules, or fortified foods) in populations with a significant prevalence of HIV.

B. Vitamin A Supplements to Improve the Health of Women and Mothers

1. *Preconception and Antenatal/Postnatal Vitamin A Supplements to Treat Vitamin A Deficiency and Improve the Health of HIV-Negative Women of Childbearing Age*

Level A Evidence for Benefit: Studies have consistently shown that in many (primarily Asian) cultures, a significant proportion of pregnant women are vitamin A deficient and suffer mild to moderate degrees of xerophthalmia (principally night blindness) and associated systemic ill health, and that these can be treated, successfully and safely, with daily or weekly vitamin A (in RDA-equivalent amounts). Biochemical indices indicate that poor vitamin A status of most women is improved following supplementation. There is no evidence of any increase in congenital anomalies among infants born to the women randomized to receive weekly (RDA-equivalent doses) of vitamin A prenatally.

2. *Preconceptual/Antenatal Supplementation with the Equivalent of a Daily RDA of Vitamin A or Beta-Carotene to Reduce Maternal Morbidity and Mortality in HIV-Negative Women*

Level B Evidence for Benefit: Evidence from the large Nepal trial (NNIPS-2) that compared weekly preconceptual and antenatal doses of vitamin A or beta-carotene in roughly RDA amounts with placebo demonstrated that both vitamin A and beta-carotene reduced maternal mortality rates by roughly 40%.

Urgent Research (Level A): Confirmative studies are needed in other populations with high maternal mortality and prevalent vitamin A deficiency to move this to level A evidence and to define the characteristics of populations to which these results are applicable. Replication studies are already under way in Bangladesh and Ghana.

3. *Preconceptual/Antenatal Supplementation with the Equivalent of a Daily RDA of Vitamin A or Beta-Carotene to Reduce Maternal Morbidity and Mortality in HIV-Positive Women*

Confounding issues (see I.A.5 above) related to potential increases in MTCT and future use of antiretroviral therapy in targeted and community-wide populations make any determination difficult at this time.

Future research should await the outcome of studies in HIV-negative women, as described above, and clarification of the indications and value of routine use of antiretrovirals in HIV-positive populations.

C. Use of Zinc Supplements in Children for the Treatment and Prevention of Childhood Morbidity and Mortality

1. *Value of Zinc Supplements in Treating Diarrhea*

Level A Evidence for Benefit: There is ample evidence that zinc combined with oral rehydration therapy (ORT), compared with ORT alone, reduces diarrheal duration and mortality and may reduce subsequent diarrheal incidence (in one study, for as long as 2 months). It is now WHO/UNICEF policy to provide a 10- to 14-day course of zinc (combined with ORT) for the treatment of acute diarrhea.

2. *Value of Daily (or Weekly) Zinc Supplementation for the Prevention of Childhood Morbidity and Mortality*

Level A-B Evidence for Benefit: Studies have shown that weekly supplementation with zinc can reduce diarrheal incidence (and, potentially, respiratory disease as well). The ongoing trials in Pemba and Nepal should provide definitive estimates of the overall benefit of community-wide zinc supplementation on childhood morbidity and mortality.

Urgent Research (Level A): Community-based trials are presently under way in Pemba (Zanzibar) and in Sarlahi (Nepal) to determine whether daily zinc supplementation in apparently zinc-deficient populations significantly reduces overall childhood mortality. If these results are positive, they will have important policy implications and will suggest the need for replication in other populations (at varying degrees of zinc deficiency, childhood mortality, co-morbid conditions, nutritional status, etc.) and for determining the optimal dosing schedule, age range of recipients, and relative effectiveness of zinc given alone or in combination with other micronutrients.

D. Use of Routine Iron Supplements for Preschool-aged Children

Level A-B Evidence for Harm among Children in Malarious-Endemic Areas: In a recently completed, carefully randomized, controlled trial in Pemba, Zanzibar, a malarious endemic area, routine daily iron supplementation of all children was associated with both a statistically significant increase in overall childhood hospitalization and an increase of similar magnitude in mortality (not statistically significant at available sample size), necessitating premature discontinuation of the trial. In a smaller sub-study, in which children received enhanced malarial detection and treatment, iron supplementation was not associated with increased morbidity among children who were iron deficient, particularly the subgroup that were both deficient and anemic, but was deleterious among children who were iron sufficient. These data add considerable weight to previous suggestions that routine iron prophylaxis can be deleterious to children in malarious areas. An identical trial in Nepal in a non-malarious population found no overall impact of iron supplementation on childhood morbidity or mortality. The Nepal trial did not contain a sub-study in which baseline iron status was measured.

The cause-specific excess malarial hospitalization of iron-supplemented children in Pemba, the absence of excess morbidity or mortality in Nepal (a non-malarious area), and the known biologic impact of iron supplements on malarial severity suggest that adverse effects related to iron supplementation of iron-replete children in Pemba were probably related to potentiation of malaria-related pathology.

Urgent Research (Level A): Oral iron is an important treatment modality for individuals with severe iron-deficiency anemia. The major rationale for community-wide, routine childhood supplementation (in communities in which iron deficiency or anemia is widespread) is the putative importance of iron status on long-term physical, motor, and cognitive development. However, there are few data that directly demonstrate this benefit. It is urgent that this issue be resolved, since studies presently (or soon to get under way) can provide this vital information by simply prolonging the followup of children who have already received supplemental iron or placebo. If supplementation of iron-deplete infants and children proves to be as valuable as has been thought, a simple, inexpensive, robust field tool will be needed to identify children in need of supplemental iron (or iron treatment) so as to be able to separate those who might benefit from iron from those who are iron replete and therefore at risk of adverse consequences in malarious areas. It would not be as essential to target treatment to demonstrably deficient children in non-malarious areas if it were shown that iron deficiency was prevalent and supplementation resulted in valuable development benefits.

Studies have confirmed that “anemia” is not a sufficiently accurate indicator of iron deficiency to serve as its surrogate; anemia can be secondary to a host of causes (e.g., thalassemia, malaria) in the presence of adequate iron stores. These issues are urgent, given the need to revise existing recommendations, particularly those for malaria-endemic regions. These concerns also highlight the need, should developmental benefits of iron repletion be confirmed, to evaluate the safety of iron supplementation in the presence of other infections, particularly HIV and tuberculosis. Similarly, alternative approaches to improving

iron/anemia status, such as deworming, need to be thoroughly evaluated for long-term benefit, safety, and effectiveness in malarious areas.

II. Supplementation with Multiple Micronutrients

A. Antenatal/Prenatal/Postnatal Multiple Micronutrient Supplementation of HIV-Negative Women

Impact of Alternative Combinations of Daily Multimicronutrients During the Prenatal Period on Fetal and Newborn Growth, Morbidity, and Mortality

Level B Evidence for Adverse Outcomes of a Full Complement of Multiple Micronutrients: Two recent, similar studies in neighboring areas of Nepal (Sarlahi and Janakpur) yielded remarkably similar results. Both studies found that a full complement of prenatal supplemental daily micronutrients may increase perinatal and neonatal mortality, possibly by increasing birth weight of larger infants, compared with supplements limited to folate/folate-iron, in poor, south Asian women (not statistically significant). Unpublished data from Pakistan supports the findings from these two Nepal trials. Whether there is a risk for only small, south Asian women, and the precise size of that risk, remains to be clarified.

Urgent Research (Level A): Given these surprising findings, and their contrast to global UNICEF recommendations, it is urgent that large-scale trials be conducted to identify modest, significant benefits and adverse outcomes of alternative combinations and doses of micronutrients on perinatal and infant outcomes. One such study will soon be launched in Bangladesh, an area culturally similar to the plains of Nepal, but probably having better baseline nutritional status and lower intrinsic infant mortality. At least two similar trials need to be conducted in Africa, one in a population with low HIV prevalence and one in which HIV prevalence is high. One such study, already conducted in an HIV-positive clinic-based population in urban Tanzania, employed highly idiosyncratic dosages and combinations of micronutrients. It is important to investigate alternative dosages and combinations of multiple micronutrients at modest multiples of RDAs in populations of varying ethnicity and baseline characteristics (protein-energy malnutrition, age, physical stature, preconceptual and antenatal nutritional status, and co-morbidities). The impact of the timing of supplementation on outcome needs further consideration (see research issues below).

Level B Evidence for Reduction in Low Birth Weight by Prenatal Iron-Folate Supplementation: Evidence from Nepal suggests that iron/folate prenatal supplementation increases the birth weight of smaller babies, which theoretically might reduce perinatal and neonatal mortality. One study from Zimbabwe found similar results.

Urgent Research (Level A): The safety and benefits of iron/folate prenatal supplementation of women needs to be confirmed and explored in other populations and environments, beginning in non-malarious areas. These could efficiently be included in the trials above and should explore multiple health outcomes of both the mother and fetus/infant. Adequate thought should be given

to new/optimal tools, parameters, and study design to best resolve these important issues.

B. Antenatal/Prenatal/Postnatal Multiple Micronutrient Supplementation of HIV-Positive Women (See I.A.5 and I.B.3 for Related Conclusions and Discussion)

Impact of Multiple Micronutrient Prenatal/Postnatal Supplements on Progress of HIV/AIDS in HIV-Positive Women

Level B-C Evidence: Evidence from one study in urban Dar Es Salaam, Tanzania suggests that multiple micronutrients may slow the progression of HIV/AIDS in infected women with more advanced disease—the group in whom ART would now be recommended. This study has undergone extensive review by WHO and related panels, where concerns were raised regarding the idiosyncratic composition and doses of micronutrients employed (ranging from 2 to over 20 times the RDA of its different constituents). A study in Zimbabwe indicated that no more than a single RDA might be needed for most of the anticipated benefits.

Urgent Research: If the results of the Tanzania study are true, it might be critically important, particularly in areas and cultures not receiving antiretroviral therapy or in HIV-positive individuals who do not qualify for HART therapy on clinical grounds. In this new era of HART and global commitment to ART, however, confirmatory studies will be challenged to conduct adequate clinical and virologic assessments and designed to fully address ethical issues. In appropriate settings, it may be useful to compare the impact of ART with and without multiple micronutrient use. Given the claimed detrimental impact of the Tanzanian regimen on MTCT, potentially related to the use of very high doses of beta-carotene (and other micronutrients), any initial studies should employ micronutrient dosages closer to an RDA. Given the apparent adverse impact of iron supplements on children in malarious areas, it is urgent to identify the benefits and any adverse reactions that might be associated with its incorporation into micronutrient supplements for populations in which HIV is prevalent in malarious areas.

C. Supplementation of Infants/Children with Multiple Micronutrients

Impact of Routine Multiple Micronutrient Supplements on Infants

Level B-C Evidence: Available evidence suggests that multiple micronutrient supplementation for infants results in better serum indices of micronutrient status, but there is poor and inconsistent evidence on whether it has any impact on growth or other health outcomes. Further, simultaneous administration of iron and zinc appear (in some studies) to interfere with the absorption/utilization/impact of one another. WHO might benefit from reconsidering its existing “iron only” recommendations, but all recommendations on iron need rethinking given issues raised above (see I.D). The IRIS (International Research on Infant Supplementation) studies were considered a good but only a first step in addressing these issues; a major research agenda needs to be formulated and carried out that identifies both physiologic and health

outcomes and the relative value of alternative micronutrients and potential competition between them (from absorption to physiologic outcome). An important issue is whether beginning supplementation at 6 months or even at birth is optimal, or whether, for maximum benefit, one needs to begin earlier, perhaps preconceptionally (as with folate). Growing evidence in support of the “fetal origins of adult disease” (the “Barker Hypothesis”) makes this even more cogent.

III. Overarching Research Issues

- A. Future interventions are likely to be increasingly population/environment specific, influenced by a host of major population determinants (anthropometry, co-morbidities, nutritional deficiency). It is important that these be delineated if one is to design programs that are valuable and policy compelling.
- B. Research issues of high immediate health relevance and urgency, identified above, should be approached in multiple populations with coordinated and standardized protocols. Such a coordinated approach has unique and critically important attributes:
 - 1. Where the results are congruent, they provide the immediate “critical mass” needed to establish policy. The multiple, randomized clinical trials conducted on vitamin A prophylaxis for children 5 months through 5 years had exactly this effect.
 - 2. Where the results are noncongruent, they often provide insights and perspectives that might otherwise go unrecognized. As an example, the simultaneous and standardized iron supplementation trials in Pemba and Nepal demonstrated adverse outcomes in endemically malarious Pemba, but not in malaria-free Nepal. These findings are crucial, as they indicate where and when iron supplementation might be safe (whether it is useful remains an important research question, but one that can be ethically pursued). Had the study first been done only in Pemba, the adverse events might have precluded any further research on iron supplementation.

Appendix: Conference Participants

Dr. Lindsay Allen
Director
USDA Western Human Nutrition Research
Center
Surge IV
University of California, Davis
One Shields Avenue
Davis, CA 95616-8669
USA
Tel: 530-752-5268
Fax: 530-752-5271
lhallen@ucdavis.edu

Dr. Zulfiqar Ahmed Bhutta
Husein Lalji Dewraj Professor & Chairman
Department of Paediatrics & Child Health
The Aga Khan University
PO Box 3500, Stadium Road
Karachi 74800
PAKISTAN
Tel: 92-21-493-0051 ext. 4724
Fax: 92-21-493-4294
zulfiqar.bhutta@aku.edu

Dr. Robert E. Black
Chair, Department of International Health
Bloomberg School of Public Health
Johns Hopkins University
615 N. Wolfe Street, E8527
Baltimore, MD 21205
USA
Tel: 410-955-3934
Fax: 410-955-7159
rblack@jhsph.edu

Dr. Erick Boy
Special Programs Coordinator
The Micronutrient Initiative
250 Albert Street
Ottawa, Ontario K1R 7Z1
CANADA
Tel: 613-782-6804
Fax: 613-782-6838
eboy@micronutrient.org

Dr. Parul Christian
Associate Professor
Bloomberg School of Public Health
Johns Hopkins University
615 N. Wolfe Street, W2041
Baltimore, MD 21205
USA
Tel: 410-955-1188
Fax: 410-955-0196
pchristi@jhsph.edu

Dr. Anna Coutsooudis
Associate Professor
Department of Paediatrics and Child Health
University of KwaZulu-Natal
Doris Duke Medical Research Institute
Private Bag 7
Congella 4013
SOUTH AFRICA
Tel: 27-31-260-4489
Fax: 27-31-209-8633
coutsoud@ukzn.ac.za

Ms. Nita Dalmiya
Project Officer, Micronutrient
Supplementation
UNICEF
3 UN Plaza, H7F
New York, NY 10017
USA
Tel: 212-326-7399
Fax: 212-735-4405
ndalmiya@unicef.org

Dr. Ian Darnton-Hill
Senior Advisor, Micronutrients
UNICEF
3 UN Plaza, 7th Floor
New York, NY 10017
USA
Tel: 212-824-6344
Fax: 212-735-4405
idarntonhill@unicef.org

Dr. Frances R. Davidson
Principal Nutritionist
Office of Health, Infectious Disease and
Nutrition
U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
USA
Tel: 202-712-0982
Fax: 202-216-3702
fdavidson@usaid.gov

Dr. Bruno de Benoist
Medical Officer
World Health Organization
20 Avenue Appia
Geneva 1211
SWITZERLAND
Tel: 41-22-791-3412
Fax: 41-22-791-4156
debenoistb@who.int

Dr. Caroline Fall
Reader in Paediatric Epidemiology and
Honorary Consultant in Child Health
MRC Epidemiology Resource Center
University of Southampton
Southampton General Hospital
Tremona Road
Southampton, Hampshire SO16 6YD
UNITED KINGDOM
Tel: 44-23-8077-7624
Fax: 44-23-8070-4021
chdf@mrc.soton.ac.uk

Dr. Suzanne S. Harris
Executive Director
International Life Sciences Institute
One Thomas Circle, NW, 9th Floor
Washington, DC 20005
USA
Tel: 202-659-0074 ext. 129
Fax: 202-659-3617
sharris@ilsa.org

Dr. Jean Humphrey
Associate Professor
Bloomberg School of Public Health
Johns Hopkins University
ZVITAMBO Project
1 Borrowdale Drive
Borrowdale, Harare
ZIMBABWE
Tel: 263-4-850-732
Fax: 263-4-850-734
jhumphrey@zvitambo.co.zw

Prof. Betty Kirkwood
Professor of Epidemiology & International
Health
London School of Hygiene & Tropical
Medicine
Keppel Street
London WC1E 7HT
UNITED KINGDOM
Tel: 44-20-7958-8105
Fax: 44-20-7958-8110
betty.kirkwood@lshtm.ac.uk

Ms. Katharine Kreis
Program Officer
Bill & Melinda Gates Foundation
1551 Eastlake Avenue East
Seattle, WA 98102
USA
Tel: 206-709-3600
Fax: 206-709-3170
katharinek@gatesfoundation.org

Dr. Chewe Luo
Senior Health Advisor, Maternal Child
Health
UNICEF
3 UN Plaza
New York, NY 10017
USA
Tel: 212-303-7942
Fax: 212-824-6460
cluo@unicef.org

Dr. Sean R. Lynch
Professor of Clinical Medicine
Eastern Virginia Medical School
151 Eastern Breezy Point Drive
Grafton, VA 23692
USA
Tel: 757-890-0620
Fax: 757-890-0620
srlynch@visi.net

Dr. Barbara MacDonald
Senior Nutrition Advisor
Canadian International Development
Agency
200 Promenade du Portage
Gatineau, Quebec K1A 0G4
CANADA
Tel: 819-994-3920
Fax: 819-953-5348
barb_macdonald@acdi-cida.gc.ca

Dr. Samuel Newton
Clinical Research Fellow
Kintampo Health Research Center
PO Box 200
Brong Ahafo Region
Kintampo
GHANA
Tel: 233-61-27304
Fax: 233-61-27304
samkofinewton@yahoo.com

Dr. Stephen Oppenheimer
University of Oxford
1 Garford Road
Oxford OX2 6UY
UNITED KINGDOM
Tel: 44-1865-512-368
Fax: 44-1865-460-804
stephen.oppenheimer@ntlworld.com

Dr. David Parker
Deputy Director
UNICEF Innocenti Research Centre
Piazza SS. Annunziata 12
50122 Florence
ITALY
Tel: 39-055-2033-346
Fax: 39-055-244-817
dparker@unicef.org

Dr. Rudiger Pittrof
Consultant in Integrated Sexual Health and
HIV
Enfield Primary Care Trust
18 C Offerton Road
London SW4 0DJ
UNITED KINGDOM
Tel: 44-20-8370-2551
Fax: 44-20-8364-6691
rudiger.pittrof@enfield.nhs.uk

Dr. Usha Ramakrishnan
Associate Professor
Department of Global Health
Rollins School of Public Health
Room 758
Emory University
1518 Clifton Road, NE
Atlanta, GA 30322
USA
Tel: 404-727-1092
Fax: 404-727-1278
uramagr@sph.emory.edu

Dr. Amy L. Rice
Adjunct Assistant Professor
Johns Hopkins University
487 Pinellas Bayway South #201
Tierra Verde, FL 33715
USA
Tel: 727-866-9650
arice@jhsph.edu

Dr. Nigel Rollins
Department of Paediatrics & Child Health
University of KwaZulu-Natal
Private Bag 7
Congella
Durban 4013
SOUTH AFRICA
Tel: 27-31-260-4491
Fax: 27-31-260-4388
rollins@ukzn.ac.za

Dr. David A. Ross
Reader in Epidemiology & International
Public Health
London School of Hygiene & Tropical
Medicine
Le Checker, 46 High Street
Knightsbridge
East Sussex TN3 25AP
UNITED KINGDOM
Tel: 44-20-7927-2264
Fax: 44-20-7636-8739
david.ross@lshtm.ac.uk

Dr. Richard D. Semba
Associate Professor
Johns Hopkins School of Medicine
550 N. Broadway
Suite 700
Baltimore, MD 21205
USA
Tel: 410-955-3572
Fax: 410-955-0629
rdsemba@jhmi.edu

Dr. Roger Shrimpton
Secretary
Standing Committee on Nutrition
c/o World Health Organization
20 Avenue Appia
Ch 1211, Geneva 27
SWITZERLAND
Tel: 41-22-791-0456
Fax: 41-22-798-8891
scn@who.int

Prof. Alfred Sommer
Dean
Bloomberg School of Public Health
Johns Hopkins University
615 N. Wolfe Street, E8527
Baltimore, MD 21205
USA
Tel: 410-955-3540
Fax: 410-955-0121
asommer@jhsph.edu

Dr. Sally K. Stansfield
Associate Director
Global Health Strategies
Bill & Melinda Gates Foundation
1551 Eastlake Avenue East
Seattle, WA 98102
USA
Tel: 206-709-3100
Fax: 206-709-3170
sally@gatesfoundation.org

Dr. James M. Tielsch
Professor and Associate Chair for Academic
Programs
Bloomberg School of Public Health
Johns Hopkins University
615 N. Wolfe Street, W5009
Baltimore, MD 21205
USA
Tel: 410-955-2436
Fax: 410-955-2029
jtielsch@jhsph.edu

Prof. Andrew Tomkins
Professor of International Child Health
Institute of Child Health
University College London
30 Guilford Street
London WC1N 1EH
UNITED KINGDOM
Tel: 44-20-7905-2122
Fax: 44-20-7404-2062
a.tomkins@ich.ucl.ac.uk

Ms. Veronica Triana
Project Manager, IVACG/INACG
International Life Sciences Institute
One Thomas Circle, NW
9th Floor
Washington, DC 20005
USA
Tel: 202-659-0074 ext. 182
Fax: 202-659-3617
vtriana@ilsa.org

Dr. Keith P. West, Jr.
Professor
Bloomberg School of Public Health
Johns Hopkins University
615 N. Wolfe Street, W2041
Baltimore, MD 21205
USA
Tel: 410-955-2061
Fax: 410-955-0196
kwest@jhsph.edu