



WORLD HEALTH ORGANIZATION

Nutrient requirements for people living with HIV/AIDS

Report of a technical consultation
World Health Organization, Geneva, 13–15 May 2003

WHO Library Cataloguing-in-Publication Data

WHO Technical Consultation on Nutrient Requirements for People Living with HIV/AIDS
(2003 : Geneva, Switzerland)

Nutrient requirements for people living with HIV/AIDS : report of a technical consultation,
World Health Organization, Geneva, 13-15 May 2003.

1.Acquired immunodeficiency syndrome - therapy 2.HIV infections - therapy
3.Nutritional requirements 4.Nutrition therapy 5.Anti-retroviral agents - metabolism
6.Energy metabolism - drug effects I.Title.

ISBN 92 4 159119 6

(NLM classification: WC 503.2)

© World Health Organization 2003

All rights reserved. Publications of the World Health Organization can be obtained from Marketing and Dissemination, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel: +41 22 791 2476; fax: +41 22 791 4857; email: bookorders@who.int). Requests for permission to reproduce or translate WHO publications – whether for sale or for noncommercial distribution – should be addressed to Publications, at the above address (fax: +41 22 791 4806; email: permissions@who.int).

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

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

The World Health Organization does not warrant that the information contained in this publication is complete and correct and shall not be liable for any damages incurred as a result of its use.

Printed in

List of Contents

	Page
Introduction	1
Conclusions and recommendations	3
Macronutrients	3
<i>Energy</i>	3
<i>Protein</i>	5
<i>Fat</i>	5
Micronutrients	5
<i>Multiple micronutrient supplements</i>	8
Nutrition and antiretroviral therapy	9
Knowledge gaps and research needs	9
References	13
Annex A	
List of Participants	7
Annex B	
Agenda	3

Abbreviations and acronyms

AEE	Activity-related energy expenditure
AIDS	Acquired immunodeficiency syndrome
ART	Antiretroviral treatment
CD4	Main targets cells for HIV. Their number decreases during HIV infection
FAO	Food and Agriculture Organization of the United Nations
HIV	Human immunodeficiency virus
IAEA	International Atomic Energy Agency
IU	International units
PLWHA	People living with HIV/AIDS
RDA	Recommended daily allowance
REE	Resting energy expenditure
TAG	WHO Technical Advisory Group on Nutrition and HIV/AIDS
TEE	Total energy expenditure
UNAIDS	The Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
WFP	World Food Programme
WHO	World Health Organization

Introduction

The objectives of WHO's first technical consultation on Nutrient Requirements for People Living with HIV/AIDS (PLWHA) (Geneva, 13-15 May 2003) were:

- to review the relationship between nutrition and HIV/AIDS infection;
- to review the scientific evidence on the role of nutrition in HIV transmission, disease progression, and morbidity;
- to review recommendations related to nutritional requirements for PLWHA;
- to identify research priorities to support improved policies and programmes.

The consultation included members of the WHO Technical Advisory Group on Nutrition and HIV/AIDS¹ and 20 experts from a variety of disciplines and agencies, including universities, governmental and nongovernmental organizations, training institutions in countries highly affected by the HIV epidemic, and organizations of the United Nations system with food, nutrition and HIV programmes (see Annex A for list of participants).

To facilitate the discussions at the meeting, five background papers were prepared:

- the effects of HIV/AIDS on energy metabolism ;
- micronutrients and HIV infection, current knowledge, methodological issues and research priorities;
- micronutrients and HIV-1 disease progression among adults and children;
- nutrition considerations in the use of antiretroviral drugs in resource-limited settings;
- the role of nutrition interventions in the prevention of HIV infection and progression of HIV/AIDS.

¹ WHO has established the Technical Advisory Group on Nutrition and HIV/AIDS as the principal international technical body responsible for making recommendations to the Director-General of WHO for appropriate action in national and international settings.

Key issues relating to nutrition and HIV/AIDS were presented and discussed in plenary (see Annex B for agenda of the meeting) based on three technical themes:

- ◇ nutrition, infection and HIV/AIDS;
- ◇ nutritional disorders in HIV infection and their implications for establishing dietary guidelines and recommendations;
- ◇ nutrition interventions and HIV.

On this basis, working groups sought to achieve consensus on macronutrient and micronutrient requirements for both asymptomatic and symptomatic PLWHA in the light of the following questions:

- What is the scientific evidence to support nutrition's role in disease prevention, and in the care and treatment of PLWHA, and is the evidence sufficient to formulate recommendations?
- What approaches can be effective in improving the health, nutrition and related outcomes in PLWHA?
- What are the critical gaps in knowledge?
- What additional research is needed?

Within this perspective, the needs of four target groups were considered:

- pregnant and lactating HIV-infected women;
- adolescents and other adults living with HIV;
- HIV-infected infants and children;
- HIV-exposed infants and children born to HIV-positive mothers.

Participants formulated conclusions and recommendations, which were further reviewed, consolidated and refined by the members of the WHO Technical Advisory Group (TAG).

Conclusions and recommendations

- Adequate nutrition, which is best achieved through consumption of a balanced healthy diet, is vital for health and survival for all individuals regardless of HIV status.

The HIV/AIDS epidemic has had a devastating impact on health, nutrition, food security and overall socioeconomic development in countries that have been greatly affected by the disease. There is an urgent need for renewed focus on and use of resources for nutrition as a fundamental part of the comprehensive packages of care at the country level.

Action and investment to improve the nutrition of PLWHA should be based on sound scientific evidence, local resources, and programmatic and clinical experience with the prevention, treatment, and management of the disease and related infections. Although there are gaps in scientific knowledge, much can and should be done to improve the health, nutrition and quality of care for PLWHA and their families and communities.

The HIV/AIDS epidemic is occurring in populations where malnutrition is already endemic. As an urgent priority, greater political, financial and technical support should be provided for improving dietary quality and increasing dietary intake to recommended levels. In addition, focused evidence-based nutrition interventions should be part of all national AIDS control and treatment programmes.

Nutrition counselling, care and support interventions for PLWHA will vary according to nutritional status and the extent of disease progression (recommendations for specific nutrient requirements are given below). HIV-related infections, such as tuberculosis and diarrhoea, not only have nutritional status as a significant determinant of their incidence and severity, but they also have severe nutritional consequences that commonly precipitate appetite loss, weight loss and wasting. Prompt diagnosis and treatment of these conditions, including use of antiretroviral treatment (ART) when indicated, can contribute to improved nutrition and health. Improved understanding of nutrition-drug interactions is needed to inform HIV/AIDS treatment programmes.

Macronutrients

Energy

- Energy requirements are likely to increase by 10% to maintain body weight and physical activity in asymptomatic HIV-infected adults, and growth in asymptomatic children.
- During symptomatic HIV, and subsequently during AIDS, energy requirements increase by approximately 20% to 30% to maintain adult body weight.
- Energy intakes need to be increased by 50% to 100% over normal requirements in children experiencing weight loss.

Adults

Studies point to low energy intake combined with increased energy demands due to HIV infection and related infections as the major driving forces behind HIV-related weight loss and wasting. Based on increased resting energy expenditure (REE) observed in studies of HIV-infected adults, it is recommended that energy needs be increased by 10% over accepted levels for otherwise healthy people. The goal is to maintain body weight in asymptomatic HIV-infected adults. Although studies of energy expenditure have not shown an increase in overall Total Energy Expenditure (TEE), this may have been the result of individuals compensating by reducing activity-related energy expenditure (AEE). Since maintaining physical activity is highly desirable for preserving quality of life and maintaining muscle tissue, it is undesirable that energy intake should only match a reduced level of AEE. The estimated energy requirement therefore allows for normal AEE levels on top of an increased level of REE.

Increased energy intake of about 20% to 30% is recommended for adults during periods of symptomatic disease or opportunistic infection to maintain body weight. This takes into account the increase in REE with HIV-related infections. However, such intakes may not be achievable during periods of acute infection or illness, and it has not been proven that such high intake levels can be safely achieved during such periods. Moreover, it is recognized that physical activity may be reduced during HIV-related infections and the recommended increased intake is based on the energy needed to support weight recovery during and after HIV-related illnesses. Intakes should therefore be increased to the extent possible during the recovery phase, aiming for the maximum achievable up to 30% above normal intake during the acute phase.

Children

There are few studies on energy expenditure in HIV-infected children. Energy requirements in children can vary according to the type and duration of HIV-related infections, and whether there is weight loss along with acute infection. Although the finding of increased resting energy expenditure in asymptomatic disease has not been replicated in children, similar to asymptomatic HIV-infected adults an average increase of 10% of energy intake is recommended to maintain growth. Based on clinical experience and existing guidelines to achieve catch-up growth in children irrespective of HIV status, energy intakes for HIV-infected children experiencing weight loss need to be increased by 50% to 100% over established requirements for otherwise healthy uninfected children.

Evidence to support specific recommendations for managing severe malnutrition in HIV-infected children is not yet available. In the absence of specific data with regard to HIV infection, existing WHO guidelines² should be followed. Research is needed on the specific energy requirements of HIV-infected children.

² *Management of severe malnutrition: a manual for physicians and other senior health workers*. Geneva, WHO, 1999.

Pregnant and lactating women

At present, there are no specific data on the impact of HIV/AIDS and related conditions on energy needs during pregnancy and lactation over and above those requirements already identified for non-infected women. For now, the recommended energy intake for HIV-infected adults should also apply to pregnant and lactating HIV-infected women.

Protein

- Data are insufficient to support an increase in protein requirements due to HIV infection.

There are insufficient data at present to support an increase in protein intake for PLWHA above normal requirements for health i.e. 12% to 15% of total energy intake. Participants were aware of the published nutritional guidance suggesting increased protein intake during HIV infection, but they concluded that these recommendations were not based on rigorously conducted studies.

Fat

- There is no evidence that fat requirements are different because of HIV infection.

There is no evidence that total fat needs are increased beyond normal requirements as a consequence of HIV infection. However, special advice regarding fat intake might be required for individuals undergoing antiretroviral therapy or experiencing persistent diarrhoea.

Micronutrients

- To ensure micronutrient intakes at RDA levels, HIV-infected adults and children are encouraged to consume healthy diets.
- Nevertheless, dietary intake of micronutrients at RDA levels may not be sufficient to correct nutritional deficiencies in HIV-infected individuals.
- There is evidence that some micronutrient supplements, e.g. vitamin A, zinc and iron, can produce adverse outcomes in HIV-infected populations.

The role of micronutrients in immune function and infectious disease is well established. However, the specific role of individual and multiple micronutrients in the prevention, care and treatment of HIV infection and related conditions merits further attention. Several studies on micronutrients and HIV are under way, and new findings should be available soon.

Observational studies indicate that low blood levels and decreased dietary intakes of some micronutrients are associated with faster HIV disease progression and mortality, and increased risk of HIV transmission. However, these studies' methodological limitations preclude definitive conclusions about the relationship between micronutrient intake and blood levels, and HIV infection.

Some studies show that there is evidence that supplements of, for example, B-complex vitamins, and vitamins C and E, can improve immune status, prevent childhood diarrhoea and enhance pregnancy outcomes, including better maternal prenatal weight gain and a reduction of fetal death, preterm birth and low birth weight. The effect of these micronutrients on HIV disease progression and mortality is under study.

Micronutrients that have produced positive health outcomes in HIV-uninfected populations include zinc supplementation for reducing diarrhoea and pneumonia morbidity in children. The safety and effectiveness of zinc supplements in HIV-infected adults and children are now being studied.

Adults

HIV-infected adults and children should consume diets that ensure micronutrient intakes at RDA levels. However, this may not be sufficient to correct nutritional deficiencies in HIV-infected individuals. Results from several studies raise concerns that some micronutrient supplements, e.g. vitamin A, zinc and iron, can produce adverse outcomes in HIV-infected populations. Safe upper limits for daily micronutrient intakes for PLWHA still need to be established.

Children

- HIV-infected 6-59-month-old children living in resource-limited settings should receive periodic (every 4-6 months) vitamin A supplements (100 000 IU for infants 6 to 12 months and 200 000 IU for children >12 months). This level is consistent with current WHO recommendations for the prevention of vitamin A deficiency in children.

Periodic vitamin A supplementation has been shown to reduce all-cause mortality and diarrhoea morbidity in vitamin A-deficient children, including HIV-infected children. In keeping with WHO recommendations, 6 to 59-month-old children born to HIV-infected mothers living in resource-limited settings should receive periodic (every 4-6 months) vitamin A supplements (100 000 IU for infants 6 to 12 months and 200 000 IU for children >12

months). There is insufficient evidence at present to recommend an increased dose or frequency of vitamin A in HIV-infected children.

No data are available on the efficacy of other micronutrient supplements for HIV-infected children.

Pregnant and lactating women

Iron-folate supplementation

- To prevent anaemia, WHO recommends daily iron-folate supplementation (400 µg of folate and 60 mg of iron) during six months of pregnancy, and to treat severe anaemia twice-daily supplements. Available data do not support a change in this recommendation for women living with HIV .

Iron-folate supplementation is a standard component of antenatal care for preventing anaemia and improving fetal iron stores. WHO recommends daily iron-folate supplementation (400 µg of folate and 60 mg of iron) during six months of pregnancy to prevent anaemia, and twice-daily supplements to treat severe anaemia.

As with other chronic infections, HIV causes disturbances of iron metabolism and anaemia. In view of iron's potential adverse effects, for example due to its pro-oxidant activity, which might accelerate disease progression, research on the safety of iron supplementation in adults and children with HIV infection is recommended. Based on available evidence, however, the approach to caring for HIV-infected women is the same as that for uninfected women.

Vitamin A

- Daily vitamin A intake by HIV-infected women during pregnancy and lactation should not exceed the RDA.

According to published reports, daily antenatal and postnatal vitamin A supplementation for HIV-infected women in well-designed randomized controlled trials not only did not reduce mother-to-child HIV transmission; in some settings it actually increased the risk. Thus, daily vitamin A intake by HIV-infected women during pregnancy and lactation should not exceed the RDA.

In areas of endemic vitamin A deficiency, WHO recommends that a single high-dose of vitamin A (200 000 IU) be given to women as soon as possible after delivery, but no later than six weeks after delivery. Research is under way to assess further the effect of single-dose, postpartum vitamin A supplementation among HIV-infected women.

Multiple micronutrient supplements

- Adequate micronutrient intake is best achieved through an adequate diet. However, in settings where these intakes and status cannot be achieved, multiple micronutrient supplements may be needed in pregnancy and lactation. Pending additional information, micronutrient intakes at the RDA level are recommended for HIV-infected women during pregnancy and lactation.

Micronutrient deficiencies are common in resource-limited settings where HIV infection is prevalent. Some studies show that different multiple micronutrient supplements may have produced a broad range of beneficial outcomes. During pregnancy, daily multivitamin supplementation with multiple RDA levels of B-complex vitamins, and vitamins C and E, improved birth outcomes in infants born to HIV-infected women, and increased maternal weight gain during pregnancy, haemoglobin concentration and CD4 cell counts. Daily use of this multivitamin supplement during lactation reduced postnatal HIV transmission and mortality in infants born to nutritionally vulnerable women and to women with immune deficiency. The supplements also reduced the risk of diarrhoea and improved infants' immune status.

Another micronutrient supplement formulation, with single RDA nutrient levels, improved birth weights among infants born to HIV-infected women. The impact of single RDA multivitamin supplements on HIV disease progression and transmission, which was not assessed, requires further study.

Adequate micronutrient intake is best achieved through an adequate diet. However, in settings where these intakes and status cannot be achieved, multiple micronutrient supplements may be needed in pregnancy and lactation. Pending additional information, micronutrient intakes at the RDA level are recommended for HIV-infected women during pregnancy and lactation.

The optimal micronutrient supplement composition that will be safe, ensure nutritional adequacy, and potentially produce the greatest benefits in HIV-infected pregnant and lactating women in different settings has not yet been defined. Additional research is required to determine the safety of nutrient supplements such as zinc, iron and vitamin A, and to determine whether different multiple micronutrient supplements are needed for HIV-infected women compared with uninfected women.

Nutrition and antiretroviral therapy

- Improved attention to diet and nutrition may enhance ART acceptability, adherence and effectiveness.
- National health authorities should prepare for ART access by training relevant personnel on counselling and managing ART's long-term nutritional aspects.

The consultation addressed a number of metabolic complications associated with the use of certain types of ART, including derangement in glucose and lipid metabolism, bone metabolism and lactic acidemia documented in industrialized countries. The consultation emphasized the need for evidence to improve management of these metabolic abnormalities in patients receiving ART. Particular consideration was given to gaps in knowledge relating to ART use in populations where malnutrition is endemic.

ART is an essential component of care for PLWHA. Nutritional interventions should be an integral part of all HIV treatment programmes. Improved attention to diet and nutrition may enhance ART acceptability, adherence and effectiveness. Countries should prepare for ART access through training on how to manage ART's nutritional dimension. More research is needed on appropriate strategies for such counselling and management in resource-limited settings.

Knowledge gaps and research needs

- New knowledge is urgently needed to provide the scientific evidence base required for making nutrition recommendations for rapid implementation.

Considerable progress has been made in building an evidence base on nutrition's importance in improving prevention of the disease, treatment and care among PLWHA. The recommendations made here underscore the urgent need to fill knowledge gaps and to refine further related conclusions and recommendations. While not exhaustive, the research questions that follow (not in order of priority) are considered crucial for improving understanding of the interaction of nutrition and HIV infection, and the impact of nutrition interventions on preventing and managing HIV infection. The term "nutrition intervention" includes both food-based approaches and micronutrient supplementation.

Impact of HIV infection on nutrition

- What is the effect of HIV infection on macronutrient requirements, particularly protein and fat? Do energy requirements for PLWHA vary at different stages of the disease, or for subjects with opportunistic infections? Are energy requirements higher for HIV- infected children and pregnant and lactating women?
- What effect does HIV infection have on micronutrient requirements for children and adults? Does maternal HIV infection affect fetal endowment of nutrients and breast-milk composition?

Role of nutrition in HIV infection

- What are optimal energy and protein intake levels during metabolic stress? Is substrate use impaired and can an excess of energy and protein be harmful?
- What are optimal nutrient guidelines for patients with chronic diarrhoea or gastrointestinal infection?
- What are safe upper limits for nutrient intakes – especially zinc, iron, selenium and vitamin A – in PLWHA?
- What effect does nutritional status have on HIV? Does nutrition affect its virulence, resistance patterns and replication?
- What is the impact of poor nutritional status on susceptibility to and transmission of HIV-1 between adults, and from mother to child?
- What effect do different infant-feeding modes have on mother-to-child HIV transmission, and child growth, nutrition and development?
- What effect does nutritional intervention have on preventing opportunistic infections and slowing disease progression?

Nutrition and ART

- What is the impact of ART in malnourished populations? Does nutritional status affect the efficacy of therapy and the risk or severity of adverse events associated with it? Would nutrition interventions – particularly in undernourished populations and lactating mothers – provided concurrently with ART result in better health outcomes?

- Are lifestyle changes, including dietary intake and physical activity, important for managing metabolic complications of ART? Should there be a different mix of such strategies in resource-limited settings where undernutrition is prevalent?

Operational research questions

- What are the effects of improved household food technology, dietary advice, and provision of food given during hospital and/or community care on nutritional recovery, disease progression and quality of life?
- Do rehabilitation protocols and approaches for managing severely malnourished children need to be modified in the light of HIV/AIDS?
- What should food and nutrition support programmes do differently because of HIV/AIDS? For example, should they change ration size or composition for HIV-affected populations? What are the criteria for targeting food to mitigate the effects of HIV/AIDS?
- What are effective nutrition interventions for food security to mitigate the nutritional impact of HIV caused by reduced agricultural productivity and/or earning capacity?

References

Macronutrients and HIV infection

Coors M et al. Acute phase response and energy balance in stable human immunodeficiency virus- infected patients: a doubly labeled water study. *Journal of Laboratory and Clinical Medicine*, 2001, **138**:94-100.

Corcoran C, Grinspoon S. Treatments for wasting in patients with AIDS. *New England Journal of Medicine*, 1999, **349**:1740-50.

Coss-Bu JA et al. Resting energy expenditure and nitrogen balance in critically ill pediatric patients on mechanical ventilation. *Nutrition*, 1998, **14**: 649-652.

Hommes MJ et al. Increased resting energy expenditure in human immunodeficiency virus-infected men. *Metabolism*, 1990, **39**:1186-1190.

Hadigan C et al. Modifiable dietary habits and their relation to metabolic abnormalities in men and women with HIV-infection and fat redistribution. *Clinical Infectious Diseases*, 2001, **33**:710-7.

Grinspoon S et al. Body composition and endocrine function in women with AIDS wasting. *Journal of Clinical Endocrinology and Metabolism*, 1997, **82**:1332-7.

Grinspoon S et al. Determinants of increased energy expenditure in HIV-infected women. *American Journal of Clinical Nutrition*, 1998, **68**:720-5.

Grinspoon S, Mulligan K. For the Department of Health and Human Services working group on the prevention and treatment of wasting and weight loss. HIV related weight loss and wasting. In Supplement: *Integrating nutrition management into HIV medical management*. Guest Editor, Celia Hayes. *Clinical Infectious Diseases*, 2003, **36** (Suppl 2):S69-78.

Kosmiski LA et al. Total energy expenditure and carbohydrate oxidation are increased in the human immunodeficiency virus lipodystrophy syndrome. *Metabolism*, 2003, **52**:620-625.

Macallan DC et al. Whole-body protein turnover from leucine kinetics and the response to nutrition in human immunodeficiency virus infection. *American Journal of Clinical Nutrition*, 1995, **61**:818-826.

Macallan DC et al. Energy expenditure and wasting in human immunodeficiency virus infection. *New England Journal of Medicine*, 1995, **333**:83-88.

Macallan DC. Metabolic abnormalities and the "wasting syndrome" in HIV Infection. *Nutrition*, 1996, **12**:641-642.

Melchior JC et al. Resting energy expenditure is increased in stable, malnourished HIV-infected patients. *American Journal of Clinical Nutrition*, 1991, **53**:437-441.

Shevitz AH et al. Elevated resting energy expenditure among HIV-seropositive persons receiving highly active antiretroviral therapy. *AIDS*, 1999, **13**:1351-1357.

Sharpstone D et al. Indirect calorimetry, body composition and small bowel function in asymptomatic HIV-seropositive women. *International Journal of STD AIDS*, 1997, **8**:700-703.

Micronutrients and HIV Infection

Baum MK et al. High risk of HIV-related mortality is associated with selenium deficiency. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology*, 1997, **15**:370-4.

Clark TD, Semba RD. Iron supplementation during human immunodeficiency virus infection: a double-edged sword? *Medical Hypotheses*, 2001, **57**:476-9.

Coutsoudis A et al. The effects of vitamin A supplementation on the morbidity of children born to HIV-infected women. *American Journal of Public Health*, 1995, **85**:1076-1081.

Coutsoudis A et al. Randomized trial testing the effect of vitamin A supplementation on pregnancy outcomes and early mother-to-child HIV-1 transmission in Durban, South Africa. *AIDS*, 1999, **13**:1517-24.

Fawzi WW et al., for the Tanzania Vitamin and HIV Infection Trial Team. Randomized trial of effects of vitamin supplements on pregnancy outcomes and T cell counts in HIV-1-infected women in Tanzania. *Lancet*, 1998, **351**:1477-1482.

Fawzi WW et al. A randomized trial of vitamin A supplements in relation to mortality among HIV infected and uninfected children in Tanzania. *Pediatric Infectious Disease Journal*, 1999, **18**:127-133.

Fawzi W et al. Randomized trial of vitamin supplements in relation to vertical transmission of HIV-1 in Tanzania. *Journal of Acquired Immune Deficiency Syndromes*, 2000, **23**:246-254.

Fawzi W et al. Randomized trial of vitamin supplements in relation to transmission of HIV-1 through breastfeeding and early child mortality. *AIDS*, 2002, **16**:1935-44.

Fawzi WW et al. Effect of Vitamin Supplementation of HIV-infected Lactating Mothers on Child Morbidity and T-cell Counts. *Clinical Infectious Diseases*, 2003, **361**:1053-61.

Fawzi WW. Micronutrients and HIV-1 Disease Progression among Adults and Children. *Clinical Infectious Diseases*, 2003, **37** Suppl 2:S112-6.

Friis H et al. HIV and other predictors of serum folate, serum ferritin, and hemoglobin in pregnancy: a cross-sectional study in Zimbabwe. *American Journal of Clinical Nutrition*, 2001, **73**:1066-73.

Friis H et al. Iron, haptoglobin phenotype, and HIV-1 viral load: a cross-sectional study among pregnant Zimbabwean women. *Journal of Acquired Immune Deficiency Syndromes*, 2003, **33**:74-81.

Humphrey JH et al. Short-term effects of large-dose vitamin A supplementation on viral load and immune response in HIV-infected women. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology*, 1999, **20**:44-51.

Kumwenda N et al. Antenatal vitamin A supplementation increases birth weight and decreases anemia among infants born to human immunodeficiency virus-infected women in Malawi. *Clinical Infectious Diseases*, 2002, **35**:618-24. Epub 2002 Aug 02.

Semba RD et al. Maternal vitamin A deficiency and mother-to-child transmission of HIV-1. *Lancet*, 1994, **343**:1593-1597.

Tang AM et al. Low serum vitamin B-12 concentrations are associated with faster human immunodeficiency virus type 1 (HIV-1) disease progression. *Journal of Nutrition*, 1997, **127**:345-351.

Villamor E et al. Effect of multivitamin and vitamin A supplements on weight gain during pregnancy among HIV-1 infected women. *American Journal of Clinical Nutrition*, 2002, **76**:1082-90.

Nutrition and Antiretroviral Therapy

Aungst BJ et al. Formulation and food effect on the oral absorption of a poorly water-soluble, highly permeable antiretroviral agent. *Journal of Pharmaceutical Science*, 2002, **91**(6):1390-1395.

Batterham MJ, Garsia R, Greenop P. Prevalence and predictors of HIV-associated weight loss in the era of highly active antiretroviral therapy. *International Journal of STD & AIDS*, 2002, **13**: 744-747.

Dube M, Fenton M. Lipid abnormalities. *Clinical Infectious Diseases*, 2003, **36**:S79-S83.

Macallan DC. Metabolic syndromes in human immunodeficiency virus infection. *Hormone Research*, 2001, **55**: S36-S41.

Raiten DJ. Nutrition, pharmacology, and toxicology: a dialectic. In: Massaro E, ed., *Handbook of Human Toxicology*. CRC Press, Boca Raton, FL, 1997

Nerad J et al. General nutrition management in patients infected with human immunodeficiency virus. *Clinical Infectious Diseases*, 2003, **36**:S52-S62.

Polsky B, Kotler D, Steinhart C. HIV-associated wasting in the HAART era: guidelines for assessment, diagnosis, and treatment. *AIDS Patient Care STDs*, 2001, **15**:411-423.

Sorensen JM. Herb-drug, food-drug, nutrient-drug and drug-drug interactions: mechanisms involved and their medical implications. *Journal of Alternative and Complementary Medicine*, 2002, **8**: 293-308.

Tang AM et al. Weight loss and survival in HIV-positive patients in the era of highly active antiretroviral therapy. *Journal of Acquired Immunology Deficiency Syndrome*, 2002, **31**: 230-236.

Annex A

EXPERT CONSULTATION ON NUTRIENT REQUIREMENTS FOR PEOPLE LIVING WITH HIV/AIDS GENEVA, 13-15 MAY 2003

LIST OF PARTICIPANTS

Dr Beatrice Amadi
University Teaching Hospital
Department of Paediatrics and Child Health
Lusaka
Zambia

Tel: (260) 1 255336/
Mobile: (260) 1 96753927
Tel/Fax: (260) 1 252269
E-mail: bamadi@zamtel.zm

Dr Philippe Chevalier
Institut de Recherches pour le
Développement (IRD)
911 Ave Agropolis - BP 64501
34394 Montpellier Cedex 5
France

Tel: (33) 4 67 41 63 32
Fax: (33) 4 67 41 63 30
E-mail: chevalph@mpl.ird.fr

Dr Wafaie W. Fawzi
Associate Professor of International
Nutrition and Epistemology
Department of Nutrition
Harvard School of Public Health
Bldg. 2, Room 329
665 Huntington Avenue
Boston, MA 02115
USA

Tel: (1) 617 432-2086
Fax: (1) 617 432-2435
E-mail: mina@hsph.harvard.edu

Dr Henrik Friis
Associate Professor
Department of Epidemiology
Institute of Public Health
Copenhagen University
Panum Institute
Blegdamsvej 3
DK-2200 Copenhagen N
Denmark

Tel: (45) 3532 7669
Fax: (45) 3532 7383
E-mail: h.friis@pubhealth.ku.dk

Professor Peter Garlick
Department of Surgery
Stony Brook University
Stony Brook, NY 11794-8191
USA

Tel: (1) 631 444 1790
Fax: (1) 631 632 2308
E-mail: pgarlick@notes.cc.sunysb.edu

Professor Catherine Geissler
Department of Nutrition and Dietetics
King's College London
Franklin-Wilkins Building
150 Stamford Street
London SE1 9NN
United Kingdom

Tel: (44) 20 7848 4351/4268
Fax: (44) 20 7848 4185
E-mail: catherine.geissler@kcl.ac.uk

Dr Steven Grinspoon
Associate Professor
Harvard Medical School
Director, MGH Program in Nutritional
Metabolism and
Clinical Director, Neuroendocrine
Clinical Center
Massachusetts General Hospital
55 Fruit Street, LON 207
Boston, MA 02114
USA

Tel: (1) 617 724 9109
Fax: (1) 617 724 8998
E-mail: SGRINSPOON@partners.org

Dr Derek Macallan
Department of Infectious Diseases
St George's Hospital Medical School
Cranmer Terrace
London SW17 0RE
United Kingdom

Tel: (44) 20 8725 0283 or 5827/8/9
Fax: (44) 20 8725 3487
E-mail: macallan@sghms.ac.uk

Dr David L. Mwaniki
Centre for Public Health Research
Kenya Medical Research Institute (KEMRI)
Kenyatta National Hospital Grounds
P.O. Box 20752
Nairobi
Kenya

Tel: (254) 2 2720890/2716125
Fax: (254) 2 2725012
Email: dlmwaniki@wananchi.com

Dr Ellen Piwoz
Center for Nutrition
Academy for Educational Development
1825 Connecticut Avenue, NW
Washington, DC 20009-5721
USA

Tel: (1) 202 884 8816
Fax: (1) 202 884-8447
E-mail: epiwoz@aed.org

Dr Sai Subhasree Raghavan
Assistant Professor in Clinical
Nutrition Medicine
Harlem Hospital and Columbia University
900 west, 190th street no 15b
New York; NY 10040
USA

Tel: (1) 212 939 2313
Mobile: (1) 3478375620
Fax: (1) 212 939 2869
E-mail: ssr12@columbia.edu

Dr Daniel J. Raiten
Office of Prevention Research &
International Programs
National Institute of Child Health and
Human Development (NICHD)
National Institutes of Health (NIH)
Room 2A-01, MSC 7510
6100 Executive Blvd
Bethesda, MD 20892-7510
USA

Tel: (1) 301 435 7568
Fax: (1) 301 435 0009
E-mail: raitend@mail.nih.gov

Dr Nigel Rollins
Department of Paediatrics & Child Health
Nelson R. Mandela School of Medicine
University of Natal
4th Floor, 719 Umbilo Road
Congella 4013
South Africa

Tel: (27) 31 260 4352
Fax: (27) 31 260 4388
E-mail: rollinsn@mrc.ac.za

Professor Andrew Tomkins
Centre for International Child Health
Institute of Child Health
University College London
30 Guilford Street
London WC1N 1EH
United Kingdom

Tel: (44) 20 7905 2123
Fax: (44) 20 7404 2062
E-mail: a.tomkins@ich.ucl.ac.uk

UN Specialized Agencies

FAO

Mr Karel Callens
Nutrition Officer
Nutrition Programmes Service (ESNP)
Food and Agriculture Organization
of the United Nations (FAO)
Via delle Termi di Caracalla
I-00100 Rome
Italy

Tel: (39) 06 57053198
Mobile: (39) 34 80518575
Fax: (39) 06 57054539
Email: Karel.Callens@fao.org

IAEA

Dr G. Venkatesh Iyengar
Head, Nutrition and Health Related
Environmental Studies Section
International Atomic Energy Agency (IAEA)
PO Box 100
A-1400 Vienna
Austria

Tel: (43) 1 2600 21657
Fax: (43) 1 2600 7 21674
Email: V.Iyengar@iaea.org

UNAIDS

Ms Gillian Holmes
Senior Advisor
Strategy and Programme Development (SPD)
Programme Development and Coordination Group
Joint United Nations Programme on HIV/AIDS
1211 Geneva 27
Switzerland

Tel: (41) 22 791 4644
Fax: (41) 22 791 4746
Email: holmesg@unaids.org

UNICEF

Dr Arjan de Wagt
Project Officer (Nutrition and HIV)
United Nations Children's Fund
UNICEF House, 3 United Nations Plaza
New York, NY 10017
USA

Tel: (1) 212 326 7159
Fax: (1) 212 735 4405
E-mail: adewagt@unicef.org

Dr Ian Darnton-Hill
Acting Senior Adviser, Micronutrients
United Nations Children's Fund
UNICEF House, 3 United Nations Plaza
New York, NY 10017
USA

Tel: (1) 212 326 6344
Fax: (1) 212 735 4405
Email: idarntonhill@unicef.org

WFP

Mr Andrew Thorne-Lyman
Public Health Nutrition Officer
World Food Programme (WFP)
via C.G. Viola 68, Parco dei Medici
00148 Rome
Italy

Tel: (39) 06 65 1 32340
Fax: (39) 06 65 1 32854
Email: Andrew.ThorneLyman@wfp.org

WHO Secretariat

World Health Organization
Avenue Appia 20, 1211 Geneva 27
Switzerland

Sustainable Development and Healthy Environments

Dr David N. Nabarro
Executive Director

Tel: (41) 22 791 2363/2413
Email: nabarrod@who.int

Department of Nutrition for Health and Development

Dr Bruno de Benoist
Medical Officer

Tel: (41) 22 791 3320/14036
Email: debenoistb@who.int

Dr Graeme A. Clugston
Director

Tel: (41) 22 791 3326/3321
Email: clugstong@who.int

Dr Mirella Mokbel Genequand
Medical Officer

Tel: (41) 22 791 2758/2759
Email: mokbelm@who.int

Mrs Sue Horsfall
Technical Assistant

Tel: (41) 22 791 2759
Email: horsfalls@who.int

Dr Sultana Khanum
Medical Officer

Tel: (41) 22 791 2624/4342
Email: khanums@who.int

Mrs Randa Saadeh (Meeting Coordinator)
Technical Officer

Tel: (41) 22 791 3315/3878
Email: saadehr@who.int

Ms Tricia Scarrott
Secretary

Tel: (41) 22 791 3878
Email: scarrottp@who.int

Child and Adolescent Health

Dr Venkatraman Chandra-Mouli
Coordinator

Tel: (41) 22 791 14814
Email: chandramoulinv@who.int

Dr Peggy Henderson
Scientist

Tel: (41) 22 791 2730
Email: hendersonp@who.int

Dr Shamim Ahmad Qazi
Medical Officer

Tel: (41) 22 791 12547
Email: qazis@who.int

HIV/AIDS

Dr Ties Boerma
Coordinator

Tel: (41) 22 791 1481
Email: boeremat@who.int

Dr Vincent Habiyambere
Medical Officer

Tel: (41) 22 791 3945
Email: habiyamberev@who.int

Dr George Loth
Medical officer

Tel: (41) 22 791 4628
Email: lothg@who.int

Annex B

EXPERT CONSULTATION ON NUTRIENT REQUIREMENTS FOR PEOPLE LIVING WITH HIV/AIDS GENEVA, 13-15 MAY 2003

AGENDA

Tuesday 13 May 2003

09.00-09.15	Welcome address	Dr D. Nabarro
09.15-09.30	Objectives of the meeting, introduction of the agenda and participants. Selection of Chair and Rapporteur.	Dr G. Clugston
09.30-09.45	Overview of the Global HIV/AIDS epidemic	Dr G. Loth
09.45-10.00	An update on current treatment and care programmes	Dr V. Habiyambere
10.00-10.30	Overview of Nutrition and HIV/AIDS Summary of HIV/AIDS-nutrition interactions	Prof. A. Tomkins
10.30-10.35	Administrative information	
10.35-11.00	<i>Coffee/Tea break</i>	
	Session I: Nutrition, infection and HIV/AIDS	
11.00-11.30	HIV/AIDS and immunity: The specific role of nutrition	Dr P. Chevalier
11.30-12.00	Effects of HIV infection on micronutrient status	Dr H. Friis
12.00-13.30	<i>Lunch</i>	
13.30-14.00	Session II: Nutritional disorders in HIV infection and their implications for establishing dietary guidelines/recommendations	
14.00-14.15	HIV/AIDS, opportunistic infections and wasting: The role of nutrition	Dr D. Macallan

14.15-15.00	Considerations for the establishment of dietary guidance	Professor. C. Geissler
15.00-15.30	Panel discussion (presenters) <i>Coffee/Tea break</i>	
15.30-16.00	Session III: Nutrition interventions and HIV	
16.00-16.30	The role of nutrition interventions in the prevention of HIV and HIV-related disease progression	Dr S. Raghavan
16.30-17.00	Multivitamin supplementation of HIV-infected women during pregnancy and lactation: A summary of the evidence	Dr W. Fawzi
17.00-17.45	Nutritional management of HIV-infected children: A review of the issues and evidence	Dr N. Rollins
18.00	Introduction to group work, break into groups, establish formalities, identify chair and rapporteur <i>Reception - WHO French restaurant</i>	Professor A. Tomkins

Wednesday 14 May

Session III: Nutrition interventions and HIV (continued)

9.00-09.30	Nutritional issues in the design and interpretation of intervention studies	Dr H. Friis
09.30-10.00	Nutritional considerations with the use of HAART in resource-constrained settings	Dr D. Raiten
10.00-10.30	Nutritional Care and Support Guidelines in the WHO Technical Reference Guide for HIV-infected women and children	Dr E. Piwoz
10.30-11.00	<i>Coffee/Tea break</i>	
11.00-11.30	Effects of HIV infection on protein and energy status, metabolism, and requirements	Dr S. Grinspoon
11.30-12.00	Panel discussion (presenters)	
12.00-12.30	Group work phase 1 Group I – Nutrition requirements Group II – Nutrition and HIV transmission	
12.30-13.30	Lunch	
13.30-15.00	Group work continued	
15.00-15.30	<i>Coffee/Tea Break</i>	
15.30-17.30	Group work phase 2 (same groups with new tasks) Group I – Nutrition and ARV therapy Group II – Nutrition and HIV progression	

Note:

Groups will discuss knowledge (micronutrients, macronutrients), gaps (research needs and priorities), and recommendations for target groups (infants and young children, adolescents, and adults, including pregnant and lactating women).

Thursday 15 May

- | | |
|-------------|---|
| 08.30-09.30 | Presentation of group work |
| 09.30-10.45 | Plenary discussions of all recommendations from Working Groups |
| 10.45-11.00 | <i>Coffee/Tea break</i> |
| 11.00-12.30 | Discussion: Next steps <ul style="list-style-type: none">▪ How to prioritise and bring other bodies on board?
(research institutions and groups, NGOs, donors...)▪ Funding and resource mobilization▪ Timetable for next steps |
| 12.30 | Close of meeting |