

FOCUSED AND GLOBAL – THE FOUNDATION FOR THE STUDY OF THE PROBLEMS OF NUTRITION IN THE WORLD

HIGH-IMPACT – RESEARCH PROJECTS TO REDUCE MALNUTRITION

INNOVATIVE – FOR SUCCESS

CAPACITY BUILDING – AS A BASIS FOR IMPROVEMENT

SUSTAINABILITY – A KEY MISSION

ENDURABLE NUTRITION – THE PRESCRIPTION FOR SUCCESS

PUBLIC HEALTH – ORIENTATED

EVIDENCE-BASED – PROACTIVITY

THE FOUNDATION AT A GLANCE

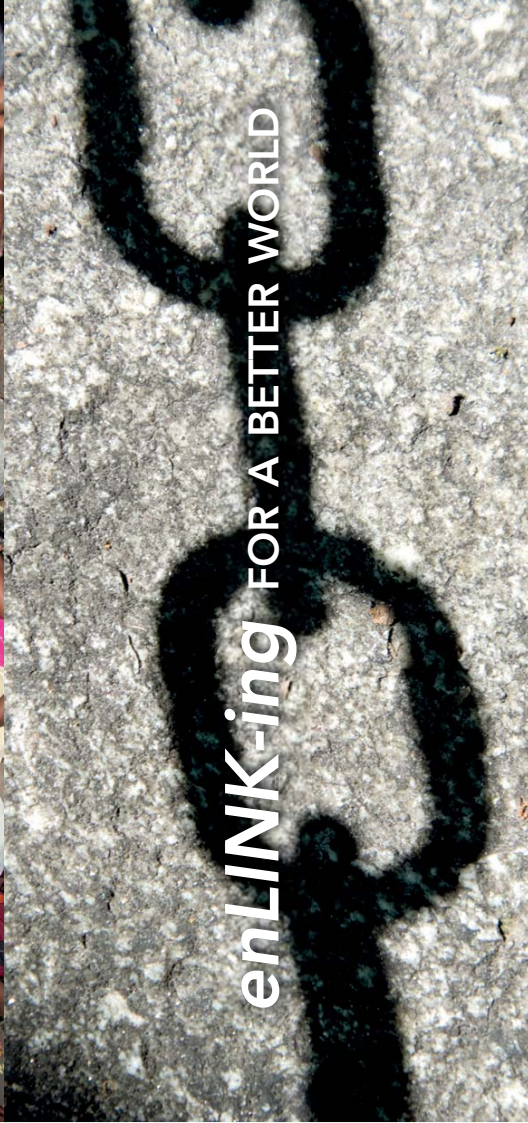
PARTNERSHIP – FOR LONG-TERM SUCCESS

SOLUTION – ORIENTED ACTION RESEARCH

enLINK-ing FOR A BETTER WORLD



CAPACITY BUILDING



enLINK-ing FOR A BETTER WORLD



PUBLIC HEALTH ORIENTATED

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evidence to support exclusive breastfeeding has accumulated, thanks to a better understanding of the early development of the human intestinal immune system and its relation to the maturation and functioning of the gut. It has become clear that breast milk is an even more complex product than previously thought, supporting not only the healthy growth of the infant, but also the development of the gut microbiota and the intestinal immune system, which harbors more cells of the immune system than all other lymphoid organs together. On page 34 of this report, Allan Walker presents new protective properties and functions of breast milk. Beyond the well-known protection of the infant by components of the adaptive immune system such as IgA, breast milk also contains components capable of supporting tolerance of beneficial microorganisms and dampening an inflammatory response, both highly supportive for the progressive colonisation of the gut by beneficial microorganisms. In turn, the gut microbiota contribute to the “education” of the immune system; they provide energy sources and vitamins to the host. They also contribute to intestinal epithelial integrity and represent a barrier against colonisation with microbial pathogens. Taken together, the contribution of the mother’s milk—which is highly adapted to her own infant and their common environment—to the protection of the infant, the maturation of its intestinal mucosa and its immune system, is even more important than previously thought. In reality, the protective functions described by Allan Walker are not “new” per se; what is new are the precious results of the research work, which enables us to understand the process. Action is badly needed to increase the low rates of exclusive breastfeeding in many parts of the world if we want to fight malnutrition and the many diseases related to it, and the Foundation does give high priority to such projects. Initiatives using novel strategies to encourage breastfeeding are welcome. One successful example—to be copied and expanded—is a study supported by the Foundation and published this year (1, 2). The investigators, a multidisciplinary team from China and Australia, show that in China short phone messages sent to breastfeeding mothers can be successful in increasing exclusive breastfeeding, but there is still a long way to go.

Susanne Anker



PRESIDENT’S MESSAGE

Malnutrition—one of the most complex challenges for public health in the world—is the research subject of most projects submitted to our Foundation. In this annual report, Walter Wahli (page 38) explains how much malnutrition, which affects 40% of the world’s population, is now caused equally by undernutrition and overnutrition. He emphasizes that malnutrition—through epigenetic modifications of gene expression—may have serious consequences for the health of not only one, but also subsequent generations. How can we best interrupt this vicious circle, especially in countries where the burden of malnutrition is highest? One of the logical approaches is to give high priority to the fight against malnutrition in young women, in order to protect the fetus during pregnancy,

and in infants and young children, for whom the impact of malnutrition in later life is highest. Many projects supported by the Foundation during the past five years concentrated on these segments of the population, using various approaches. One was encouraging exclusive breastfeeding during the first six months of life, which is recognized to be the best health-promoting measure for infants, protecting them against both under- and overnutrition. But the rates of exclusive breastfeeding mentioned in many submitted projects are alarmingly low, often in countries with a very high burden of malnutrition. Exclusive breastfeeding has always been recommended with convincing arguments by the WHO and other international organisations as well as by health professionals. But in recent years additional

One of the Foundation's main aims is the transfer of scientific and technological knowledge to low-income countries. The Foundation advances nutritional science both by supporting nutrition research projects in established institutes and universities and by giving focused support to existing nutrition schools and educational programs. To further fulfil the mandate of the Council and also encourage sustainable improvement in nutrition, a proactive, strategic area of activities was introduced in 2003: The enLINK Initiative.

PROJECTS INITIATED BY THE FOUNDATION

THE enLINK INITIATIVE

- Promotion of specific research questions
- The enLINK digital library
- Small mobile enLINK library trunk in English & French & Spanish
- The large enLINK library trunk





THE enLINK INITIATIVE

Sustainability and public-health relevance are key issues for all activities of the Foundation. Research projects need to result in a short- and long-term public-health implementation. Knowledge and know-how have to be sustainable at all levels of the population.

The vast experience of the Foundation's Council members as well as the Foundation's past activities led to the creation of the **enLINK Initiative**, a project which illustrates the proactivity of the Foundation regarding its core issues.

This initiative focuses on information transfer in the area of nutrition and malnutrition as well as on the resolution of specific research questions and their implementation at the public-health level. The core competence and activity of the Foundation is the support of nutrition research in low-income countries. The enLINK initiative is an add-on to our key activities to improve the research capacity.

The name enLINK comes from the old English verb **"to enlink"**, meaning **"to connect, as by links"** or **"to chain together"**. The analysis of the semantic relations of **"enlink"** reveals related words which illustrate our central concepts and aims: to connect, to join, to associate, to unite, to tie, to conjoin.

Our mission is to link and join cultures; to associate and conjoin institutions and people locally to study and diminish the problems of malnutrition globally.

Malnutrition can only be solved by **"enlinking"**—connecting—different strategies and approaches. Malnutrition has to be addressed universally by joint strategies which address many levels, looking at the level of medical issues (such as infection) and hygiene (such as water quality), proposing changes at the level of agriculture as well as in the society at large, and, last but not least, working to improve the level of education and information.

The enLINK Initiative has four main levels:

1. exploration in nutrition – building practical research capacity
2. education in nutrition
3. electronic nutrition – the enLINK digital library
4. endurable nutrition

The digital **enLINK** library is currently offering free full-text access to 8 nutrition journals and more than 30 e-books. The library is accessible free of charge to registered users who all receive a personal password—registration is also free as long as the applicant comes from a low-income country. The library is continuously updated and adapted to specific needs and in response to user feedback. Evidence and content which make it into textbooks are usually more practice-related than the research knowledge from latest findings which is published in research journals. Therefore the weight of the library lies more in the e-textbook section to assure a good basic knowledge transfer as well as knowledge accessibility.

Despite all the advances in information technology, books and printed materials will remain indispensable. During the reporting period, small and large trunks were sent to different institutions in Africa. The enLINK trunks initiative concluded at the end of 2014, and for the moment the major efforts will be focused on digital content.



"Don't find fault. Find a remedy."
Henry Ford



DO NOT NEGLECT THE BASIS

For nearly 50 years, the Nestlé Foundation has promoted nutrition research in low- and lower-middle-income countries to improve health and well-being. During all these years the aim of the support has been to develop and strengthen local capacity. The local ownership of the research idea and the research activities was and still is a central aspect for funding. The result of this longstanding strategy are more than 500 published research papers and often local or even international implementation of the findings. The research projects span the whole enLINK circle (Fig. 1), and they have contributed to better health and nutrition of the whole population, but especially of women and children.

The “Health Impact Pyramid” (1), as also discussed in last year’s report, underlines the importance of a prioritized global approach to improve health and nutrition by focusing on specific public health issues in a hierarchical approach. Socio-economic determinants of health (i.e. socio-economic inequality, poverty, housing, etc.) are at the base of the pyramid. Epidemiological data from the last few years emphasize the importance of socio-economic determinants as the major driver for the global disease burden and untimely death. Nearly half of the world population lives on less than 2.50 USD per day; 80% live on less than 10 USD per day (2). Well over 90% of these individuals live in low-income countries, the majority of them being women and children.

Most diseases disproportionately affect the poor. This is especially the case for infectious diseases and accordingly the term “infectious diseases of poverty” (IDP) has been coined (3). These diseases include the neglected tropical diseases (NTD) as well as the “classic” infections of malaria, tuberculosis

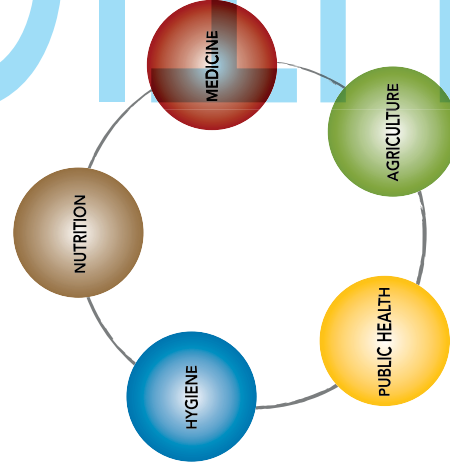


Figure 1: The enLINK circle: The five central fields of intervention for the control of malnutrition, hunger and poverty

and HIV (3). The summary term “infectious diseases of poverty” implies that it is not enough to control only one disease; instead, the whole package of diseases needs to be addressed, which means that a more holistic, but at the same time also more causal, basic approach needs to be chosen for the control or elimination of these diseases (3, 4).

“Neglected tropical diseases” is a well-chosen term pointing to a key aspect: these diseases have been neglected. Along the same lines, the geographic areas with a high death and disease toll from “diseases of poverty” have been neglected regarding basic



health care, creation of a health workforce, education (including literacy), knowledge synthesis and sharing and, last but not least, knowledge implementation. The numbers of physicians cited below as well as the two Worldmapper maps (see Figure legend) convey a very clear—and often still ignored—message. Public health and nutrition knowledge cannot be implemented without a functional community-based health care system and an adequately trained staff.

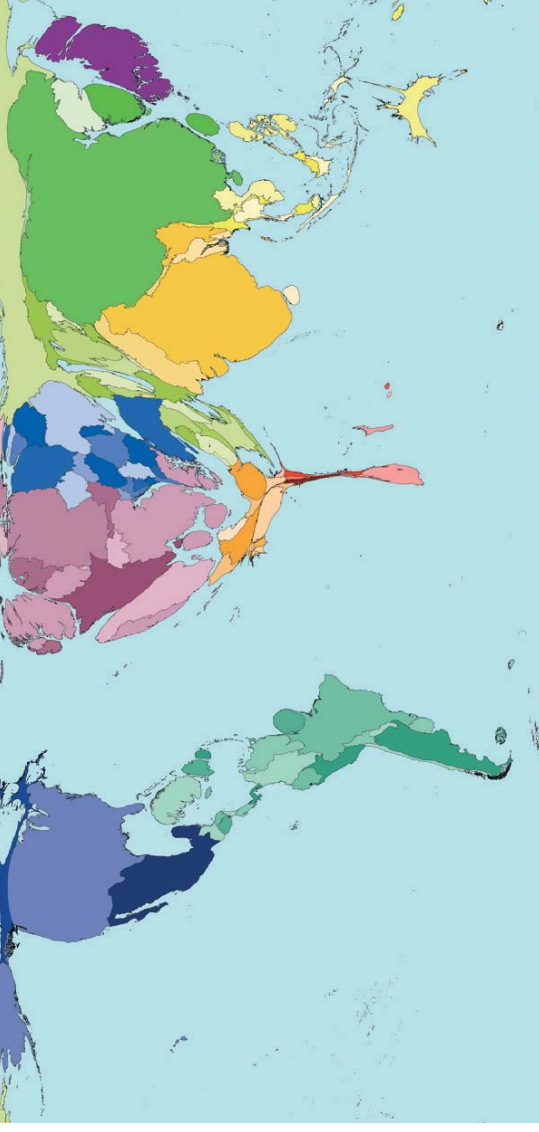
As we all know, these diseases can be controlled in many regions of the world—usually in the Northern, wealthy parts of the globe (4). However, therapy and especially prevention and targeted public health strategies at the level of the communities (i.e. community-based interventions) will reduce this disease burden also in the poor, disadvantaged regions of the world (5). To achieve this, a basic health care system with an adequate number of hospitals, community-based health centers equipped with medical doctors, nurses and health workers is needed. The latter strategy is hampered by the shortage of health care personnel. The global medical and paramedical workforce is in crisis in most low- and lower-middle-income countries (6). It seems difficult to estimate the size of the healthcare workforce in many places of the world: Hoyer et al. reported that no national data about the health workforce were found for 23 of the 57 countries considered by the WHO to be in a health workforce crisis (7). The same article reports that across low-income countries, the general surgeon density ranged from 0.13 to 1.57 per 100,000 population (7). The obstetrician density was found to be as low as 0.042 per 100,000 and the anesthesiologist density in some geographic areas was simply non-existent (7). Just for comparison, the general surgeon density in the US is approximately 4.82 in rural and 8.48 in urban areas (8). According to a recent WHO report, 11 of the 47 Sub-Saharan African nations do not have a medical school and 24 have only one each (6). As compared to many other numbers, these medical school numbers are easy to collect and most likely correct—since they do not require a specific epidemiologic sampling technique or specific definition criteria but only the ability to count up to 168, corresponding to the number of medical schools in Sub-Saharan Africa (6). (For comparison: in the USA, there are more than 140 officially accredited MD-granting institutions.)

The relation between poverty and poor health is well established. Usually poverty is regarded as the cause of ill health. However, it is well known that poor health is also the driver for increasing poverty. This bi-directionality leads to a vicious circle. An old saying attributed to Schopenhauer reads that “Health is not everything, but everything is nothing without health”. Escape from poverty starts with good health; yet impaired health is one of the major drivers of poverty. The central importance of basic health care

at the community level and the key role of community-based interventions in the health and educational sector becomes self-explanatory. These geographic hotspots of poverty-related diseases are also classified as “resource-limited areas”—a more appropriate term might be “resource-neglected areas”.

This constellation calls for the investment in local capacities and capacity building through education, transfer and synthesis of know-how, training of health care professionals and building of a health care and educational infrastructure. Implementation of the vast knowledge in disease prevention and therapy can only be successful if there is local capacity.

The Foundation recognized since its early days that it is the local capability and capacity which is crucial for any improvement and further development. Well-trained professionals at all levels remain the basis for health maintenance and poverty reduction. This is what the Foundation has pursued for nearly 50 years: build local capacity in nutrition research (often in the person of physicians) for a local, sustainable implementation. Applicable knowledge is the best currency to combat malnutrition and reduce poverty.



Map Legend:

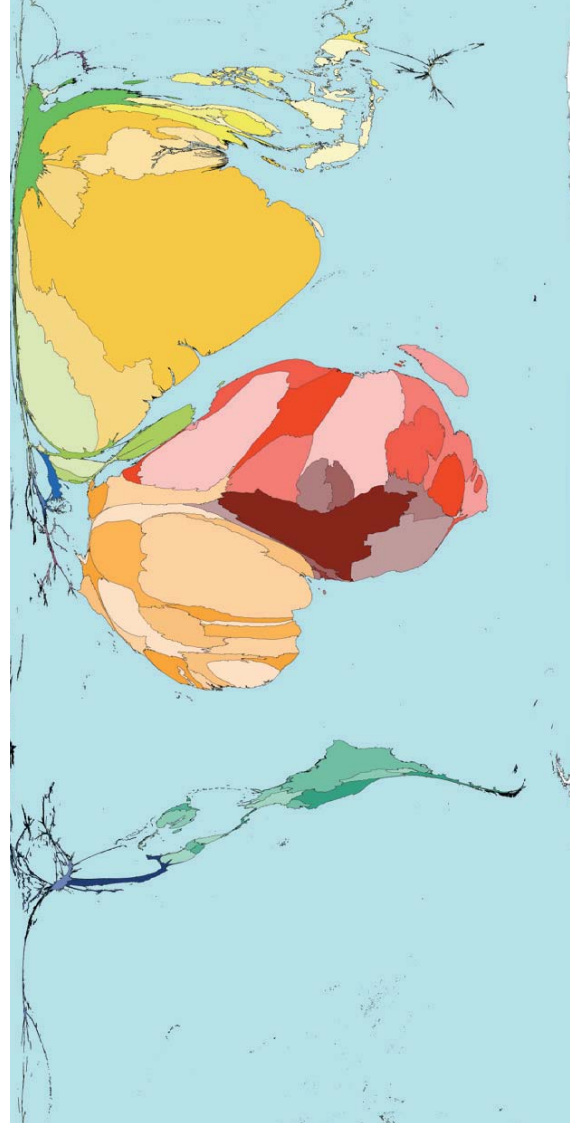
Physician Workforce (above):

The largest number of physicians are found in China (corresponding to the largest territory on the map). A homogeneous distribution of doctors corresponding to the world population would result in a rate of 124 physicians per 100,000 individuals. As can be seen clearly, more than 50% of the physician workforce is based in territories where about 1/5 of the world population is living. On the other end of the spectrum, the worst-served 1/5 of the world population has only 2% of the physician workforce. Territory size on the map corresponds to the proportion of all physicians (doctors) that work in the corresponding country or territory.

Maternal Mortality (bottom):

According to the WHO, every day approximately 800 women die from preventable causes related to pregnancy and/or childbirth. The map shows that the highest rates of maternal mortality are found in the Southern hemisphere. In developing countries the maternal mortality ratio is around 230 per 100,000 live births—in certain countries this rate is as high as 1,000. The size of the different territories corresponds to the proportion of deaths of women during the pregnancy period, up to 6 weeks after giving birth.

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THE enLINK LIBRARY - 7d/24h

e-journals in nutrition

e-textbooks

e-books

There is no education and advancement in research without access to information. Information and information access is a basis for advancement for anybody in any aspect of life, and the right to information is actually one of the basic human rights as anchored in the Universal Declaration of Human Rights. Eight years ago, the Foundation constructed the Internet-based enLINK digital library of nutrition research, which is now appreciated by users in nearly 20 low-income countries.

The enLINK library is a concerted action between OVID Technologies, certain publishers, and the Foundation. As of December 2014, Annual Reviews, OVID Technologies, Wolters Kluwer Health, Inc., and Lippincott Williams & Wilkins participate in the enLINK library to offer high-level digital content.

For nutrition information, the enLINK library is for many users an established and appreciated source of information. After a recent "booster" with a new Internet appearance, new journals, and many new e-books in nutrition and, last but not least, a completely new technological infrastructure platform, user registration and usage increased again. The enLINK library targets individual users in low-income countries who are interested in nutrition and nutrition research.

Presently 8 journals and 33 e-books are accessible in full-text mode. Users will find the content and information they need in a small number of high-quality sources. "Small but beautiful", as one user told us: the enLINK library is small, but nevertheless



you can easily find reliable and evidence-based information on nutrition and health-related topics. In the enLINK library there is no danger of being drowned in the information flood.

The enLINK users have access, with the help of OvidSP, to e-journals and book content. Further, users can take advantage of OvidSP's search, alerting, and results management tools to stay current on their research interests. The language options (English or French) make the use of this tool even more user-friendly. There are no "opening hours" for this library – enLINK can be accessed 7d/24h.

If you are from a low-income country and if you are working in your country of origin, apply at www.enlink.org to become a registered user. (Please read the instructions carefully and follow the guidelines. Registration and use of the enLINK library are both free of charge.)

enLINK user statistics (as of December 31, 2014)

- 252 registered users
- Registrations from 20 countries
- Regular access from users living in Morocco, Uganda, Ghana, Nigeria, Ethiopia, Indonesia, Myanmar, Vietnam, Nepal, Kenya, Sudan, Cameroon and Togo
- Average duration of access: 11 minutes
- Most frequently accessed journal: Nutrition Today

Most frequently accessed books: Essentials of Life Cycle Nutrition, Modern Nutrition in Health and Disease, and Essentials of Human Nutrition



The orange library

THE enLINK LIBRARY TRUNKS

Who does not know the famous book *Where there is no doctor* by David Werner? This book and many others are included in the orange enLINK book trunk from the Foundation since "where there is no Internet", books are indispensable.

There is no education without access to information. In today's world, information access is equated with access to the Internet and other electronic media. Yet despite all the developments in information technology and computer science, this statement is in part a misconception. It is well known that a combined, integrated access to hybrid collections of printed and electronic resources is at present the most powerful tool for education. In addition, there are many geographic areas without access to the Internet or only at high cost. There the mobile enLINK library trunk fills the gap.

The mobile enLINK library consists of an orange metal trunk containing more than 120 books, brochures and guidelines from the field of nutrition and health. Nutrition cannot be viewed separately from other disciplines, especially medicine, agriculture or public health. Accordingly, the enLINK trunk also contains books such as Harrison's textbook of medicine and a textbook of tropical medicine. One can find "down to earth", ready-to-use guidelines for the treatment of severe malnutrition or the construction of a home garden.

The large trunk ENGLISH

Colour: orange
Height: 1.0 m
Weight: 80 kg
Number of books: 35
Number of brochures, booklets, etc: 120
Total number of pages: 30,000

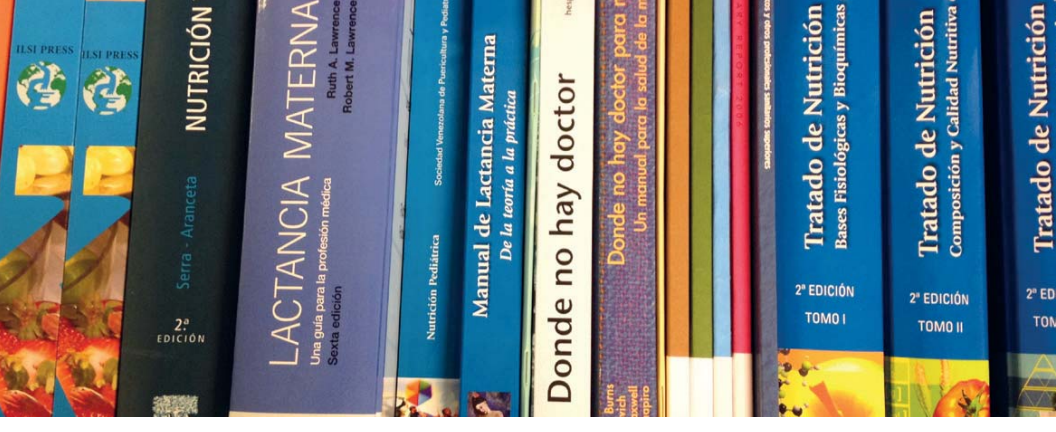
The small trunk ENGLISH, FRENCH & SPANISH

Colour: orange
Height: 33 cm
Weight: 30 kg
Number of books: 10
Number of brochures, booklets, etc: 40
Total number of pages: 10,000

The enLINK trunk has the same size and layout as the Blue Trunk Library from the World Health Organization (WHO). The enLINK trunk was created as an addition to the WHO Blue Trunk Library and covers the major issues around the theory and practice of nutrition.

The enLINK nutrition library trunk was offered as a present free of charge (including free shipment) to selected nutrition institutes in low-income countries. Order forms for the enLINK trunks are available on the Foundation's website. However, 2014 was the last year where a larger quantity of small and large enLINK trunks was shipped. Now only a few small complete trunks remain available, which will be shipped shortly. For the moment the central focus will be on the distribution of digital content via the digital enLINK library.

So far a total of 165 trunks have been shipped to more than 30 different countries. During 2014, 19 small and 3 large trunks were shipped to 7 institutions in 6 countries. Twelve of the 19 small trunks were shipped to French-speaking countries or institutions.



THE enLINK TRUNK



OTHER ACTIVITIES

NEW RESEARCH PROJECTS

INSTITUTIONAL SUPPORT

OTHER CAPACITY-BUILDING ACTIVITIES



In 2014 the Council decided
to fund 7 research projects.

COMPLEMENTARY FOOD

NUTRITION GAP MAPPING

FOOD SECURITY

MICROBIOTA

FORGOTTEN CROPS

NEW RESEARCH PROJECTS

FOOD SOVEREIGNTY

NUTRITION COUNSELLING

COMPLEMENTARY FOOD

Effects of feeding style and fiber content
of complementary foods on the appetite
of Ethiopian infants

Kaleab Baye

Center for Food Science and Nutrition
Addis Ababa University
Addis Ababa, Ethiopia

USD 39,392

Undernutrition and micronutrient deficiencies are highly prevalent in developing countries. These deficiencies are associated with poor growth, impaired cognitive development and poor health status. In Ethiopia, 44% of children under five years of age are stunted. After the age of two, the negative effects of stunting are irreversible. Low dietary intakes are among the immediate determinants of poor nutritional status and can be related to subject factors, feeding style, or the food characteristics. Dietary intake surveys on infant and young children in Ethiopia have indicated that energy and nutrient intakes were below recommendations and that caregivers are often concerned over the low appetite of their children. Whether this is associated to the high fiber contents of the complementary foods that are prepared from high-extraction-rate flours and/or to inappropriate feeding styles remains unknown. The proposed project aims to evaluate the effect of responsive feeding and extraction rate of flours used for complementary food preparation on the dietary intakes of 9- to 12-month-old infants in the context of rural Ethiopia. The current feeding styles of infants in Ethiopia will first be evaluated through in-home observation of feeding episodes to then define and formulate responsive feeding messages adapted to the local context. These messages will be delivered to caregivers through training sessions, and the effect of adopting the messages on the dietary intakes of infants will be evaluated through in-home weighed meal observations using a within-subject crossover design. Whether dietary intake is influenced by flour extraction rate and how this affects the outcomes of responsive feeding will also be evaluated. The intake of two test meals formulated from high- and low-extraction-rate flours will be evaluated, in the presence/absence of responsive feeding.

GAP MAPPING

Nutrition Gap Map: A comprehensive
mapping, quality assessment and
summary of nutrition-relevant systematic
reviews

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and

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USD 100,050

There has been a recent resurgence of nutrition as a priority on the global health and development agenda (for example, the SUN movement and the recent donor financing commitments) due to the increasing concerns about the stagnation in improvements in nutritional status. The 2013 Lancet Series on Maternal and Child Nutrition presented the latest available evidence for a set of key nutrition-specific interventions and a range of nutrition-sensitive programs, and outlined priorities for primary research in both domains. Other previous initiatives to identify gaps and methodological weaknesses in the existing systematic review literature on nutrition-relevant interventions have been pursued, and highlighted the existing diversity between the methods, contextual adjustments, conclusions and recommendations. However, the scope has been limited to certain selected areas from the broader nutrition domain. To build upon and complement the previous work, this study proposes to undertake a comprehensive mapping, quality assessment and summary of existing evidence syntheses that span the broad range of nutrition-relevant interventions. We will ground this exercise in the conceptual framework that guided the 2013 Lancet series, which outlines the multi-level and multi-sectoral pathways by which improved nutrition and its long-term benefits can be realized. This framework presents the normative landscape of potential nutrition action against which we will map and critically assess the existing body of evidence syntheses on nutrition-relevant interventions. Then the researchers will be able to identify areas in which evidence syntheses are insufficient or lacking altogether. The gap map will encompass gaps in the theory and implementation strategies for nutrition-related interventions and the consequent lack of implementation/application of the current knowledge. It will also highlight the gaps in the application of the current knowledge in certain countries/regions of the world.

FOOD SECURITY

A cohort analysis of the sustainability of food insecurity control programs in the northwest of Iran

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USD 30,000

Food security has been defined as access by all people at all times to enough food for an active and healthy life. Food insecurity, however, is frequent in both developed and developing countries, affecting from 5% to 25% of the general population. Beginning in 2009, a program was funded by the Nestlé Foundation to assess food insecurity, its influencing factors and control measures in the northwestern region of Iran, and to develop a public health model to reduce the rate of household food insecurity in the region. According to the findings, the prevalence of food insecurity declined by 7.3% after the intervention. Now, four years after the intervention was completed, a time during which there have been tough sanctions against Iran, resulting in a remarkable increase in the prices, and decrease in the availability and accessibility of food in the country, we want to look at the sustainability of the previous program in the same setting. The total populations in the area (2,911 households with a total of 15,070 individuals) in three suburban districts in the northwest of Iran were recruited in the previous program. This new proposal intends to follow up the same population after four years for the following objectives: 1) to re-assess the food insecurity in the study population, 2) to re-assess the causes of food insecurity in the study population, and 3) to explore the sustainability of the interventions.

MICROBIOTA

Minimizing the negative effect of iron supplementation and fortification on gut microbiota using local resources

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USD 49,948

Iron supplementation and fortification are effective ways to overcome iron deficiency anaemia but they have a negative effect on gut microbiota balance. Pathogenic bacteria need iron for growth; thus, iron supplementation can induce the rapid growth of gut pathogens. EDTA is a strong metal chelator, so using NaFeEDTA is a potential way to increase the bioavailability of iron in order to prevent the iron uptake by pathogens. NaFeEDTA can increase the iron absorption two to three times better than FeSO₄, even in the presence of phytic acid. Probiotics contribute in maintaining gut microbiota balance and produce short chain fatty acid. Probiotics can support probiotics by providing selective substrates for its growth. This study is to determine the effectiveness of the administration of synbiotic fermented milk during iron supplementation and fortification on gut microbiota balance. The subjects will be 116 children (8-13 years old) with depleted iron (serum ferritin < 15 µg/L). Subjects will be divided randomly into groups receiving: 1) iron supplement (FeSO₄ syrup, 10 mg Fe); 2) iron supplement and synbiotic fermented milk; 3) fortified cassava biscuits (NaFeEDTA, 10 mg Fe); and 4) fortified cassava biscuits and synbiotic fermented milk. Synbiotic is made from an Indonesian local isolate of *Lactobacillus plantarum* Dadi'3 and fructo-oligosaccharides (FOS). The intervention will be carried out for three months, during which time iron syrup or biscuits will be given twice a week and milk six times a week. Gut microbiota (*Lactobacilli*, *L. plantarum*, *Bifidobacteria*, *E. coli*, *enterobacteria*, *Shigella* sp, and *Salmonella* sp) will be determined by culture technique with selective media agar and quantitative real time-PCR. Ferritin will be measured with Elisa, haemoglobin with azidimethemoglobin, Incremental Cost Effectiveness Ratio (ICER) analysis will be performed to know the most effective intervention. After finishing this study, we will collaborate with the local community, especially women's groups and the local government, to guarantee the sustainability of the project.

FORGOTTEN CROP

The efficacy of biofortified pearl millet in a randomized controlled trial with children <2y in rural Eastern Kenya

Mueni Ndiku & Joan Sabate

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School of Science and Technology
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Baraton, Kenya

and

Department of Nutrition
School of Public Health
Loma Linda University
Loma Linda, California, USA

USD 141,475

In Kenya, thirty percent of children younger than five are stunted as a result of chronic malnutrition. Stunting in the first two years of life leads to irreversible damage, including shorter adult height, lower attained schooling, reduced adult income, reduced IQ, and decreased offspring birth weight. Until 50 years ago, pearl millet was a staple crop in Eastern Kenya, but it has now been replaced by maize in many areas. Dr. Ndiku's doctoral research, conducted in 2009, established that children in this region derive about 62-68% of their daily energy from grain and indicated that those who subsisted on pearl millet had a 15% higher mean energy intake than those reliant on maize. They also had a greater intake of most key nutrients. This project will be a dietary intervention trial with biofortified pearl millet in the Ukambani region, currently subsisting on maize. Our previous pilot project, conducted recently and funded by the Nestlé Foundation, established that villages with maize as their main food will welcome a change to pearl millet. This study will be conducted with 150 households in two arms over three years. All households will have children 0 to 12 months old at baseline. The following steps will be taken: Year 1 – Identify appropriate villages; design an educational program for both preparing and incorporating pearl millet into the daily diet; network with the Ministry of Agriculture to start recruitment; collect baseline data and start the intervention. Year 2 – Conduct trial: group 1 villages are the control and group 2 is an intervention with biofortified pearl millet; collect biological samples and anthropometric indicators from children in both village groups. Year 3 – Complete intervention; analyze biological and anthropometric data; draft publication; report results; develop ongoing UEAB community service projects to continue.

FOOD SOVEREIGNTY

Promoting food sovereignty through a cooperative model for sustainable organic farming in the Mayan Region

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Universidad Intercultural Maya de Quintana
Quintana Roo, México

and

University of Twente
Enschede, Netherlands

USD 20,000

Agricultural cooperatives are emerging as an economic alternative model to improve the lives and nutrition of rural families in eastern Mexico. Throughout the social economy, the families with female leadership have developed a social structure that helps them achieve food sovereignty for their children. The Mexican government has a history of paternalism; the lack of appropriate public policies is remedied with a large number of social programs which are created to prevent the growing poverty in the Mexican population with high rates of malnutrition. The beneficiaries of these resources are the vulnerable classes of society, children, elderly and women, but these efforts are inefficient because the situation involves structural problems in the country. Looking for quality food for their families and a source of income, female agricultural producers in eastern Mexico work together, exchanging their products as a way to improve their nutritional level by obtaining a variety of fruits and vegetables for their consumption, and on the commercial side they gather their products to obtain the largest representation in the market. Cooperatives are based on the values of self-help, self-responsibility, democracy, equality, equity and solidarity. Cooperative members believe in the ethical values of honesty, social responsibility and solidarity. Based on this definition, the figure of the cooperative is defined as an autonomous association of persons who have been united voluntarily to meet their common economic, social and cultural goals in the figure of a democratically controlled company. Some of the cooperatives located in the Mayan region of Mexico present a successful model of operation, which allows the Mayan women of the region to have a healthier nutrition and to obtain a higher income exchanging their products. It is necessary to identify the representative elements of these successful cases in order to replicate the model in the Mayan region, with the goal of promoting good practices.

FEEDING PRACTICES

Effect of personalized nutritional counselling on child growth and feeding practices in Burkina Faso

Yassinme Elysee Somasse

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Bobo Dioulasso, Burkina Faso

USD 20,000

Infants are particularly vulnerable during the transition period when complementary feeding begins to supplement breast-feeding. In southwestern Burkina Faso, inappropriate complementary feeding is more often due to inadequate knowledge about feeding practices than to the lack of food. A conventional group education offered by a previous NGO program in the region showed insufficient effect on infant feeding practices. They aim at testing the effect of personalized counselling of caregivers on children's growth and complementary feeding practices in this region of Burkina Faso, assuming that personalized counselling enhances feeding practices and consequently a child's growth. A counselling guide will be developed by means of a rapid anthropological assessment procedure (RAP) in order to take into account the key determinants of infant feeding. The effect of personalized counselling administered by community health workers (CHW) will be assessed in a cluster-randomized trial where the villages will form the randomization units, with 16 villages in the intervention group and 16 in the control group. In the intervention arm, the counselling will be done during home visits monthly for 6 months. In the control arm, caregivers will receive a monthly group education at a community center for 6 months also. They will enroll the mothers and their children (aged 6-7 months) after obtaining consent. They will train the nurses of four health centers, who will in turn train the CHW as counsellors. The outcomes are child weight gain and secondary complementary feeding practices, height gain, dietary diversity and household food security. The study will enable community and health-facility capacity building and will inform nutrition policy and practices in Burkina Faso where a national policy of health system integration of community-based activities was developed in 2012. The total duration of the study is 15 months.



One of the major aims of the Nestlé Foundation is the transfer of sustainable capacity-building knowledge to low-income countries. During 2014, several specific capacity-building activities were supported.



INSTITUTIONAL SUPPORT AND OTHER CAPACITY-BUILDING ACTIVITIES

AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT

Local creation and dissemination of nutrition knowledge is of great importance. There are only a few nutrition journals on the African continent, one of them being the African Journal of Food, Agriculture, Nutrition and Development (AJFAND) (see also <http://www.ajfand.net>). The AJFAND is meant to create awareness of the multiplicity of challenges facing Africa that lead to abject poverty and destitution. The Foundation is supporting this important effort with a regular contribution for the infrastructure as well as for each issue. The journal is only available as a web-based publication. The submission of original articles and other contributions can only be encouraged.

DISSEMINATION OF RESEARCH RESULTS

During 2014 the Foundation supported several researchers to attend conferences in the United States, Asia as well as Europe to present results from their research projects which were supported by the Foundation.

THE ENLINK TRUNK

During this year 19 small and three large trunks were shipped to seven institutions in six countries. Twelve of the 19 small trunks were shipped to French-speaking countries. The feedback from enLINK trunk users clearly underscores that books will most likely not disappear. A few years ago it was assumed that e-books and e-documents would cannibalize printed books. Since printed books are close to perfection they will instead outlive any digital book.

NEW EDITION OF NUTRITION ET SANTÉ AND "BIBLIOTHÈQUES MÉDICALES" FOR 10 NURSING SCHOOLS

In nearly 20 African countries, French is one of the official languages. English as the global language in education and research as well as daily life still remains a handicap. There are not many practical books on applied nutrition in French. Accordingly, in the year 2013 the Foundation supported the printing cost for a 250-pages paperback book entitled Nutrition et santé ("Nutrition and Health") by Dr. Jacques Courtejoie, Centre de Promotion de Santé (CPS) in Kangu-Mayumbe (Congo). In 2014 Nutrition et santé was printed and in addition, ten nursing schools in the Congo were equipped with a compilation of 460 different educational brochures, manual and books. These "bibliothèques médicales" will lay the ground for an educational library in these nursing schools. The schools are located throughout the Congo—in Unikis, Sayo, Kisangani, Budjala, Kungu, Ngulu, Gemena and Ikela. In Ikela, three different institutions have been equipped with the "bibliothèques médicales".

The CPS is one of the major producers of educational materials for medical doctors, nurses and midwives in the Congo. The books are not only distributed locally—for instance, all midwifery schools in the Congo depend on educational material from the CPS—but also to other French-speaking African countries. CPS fills a gap for Francophone Africa. In the Congo, as in many other countries, printed books are and will be indispensable for the near and most likely also distant future.

ENLINK TRUNKS FOR THE CENTRE FOR HEALTH PROMOTION

For 49 years, the Centre for Health Promotion in Kangu-Mayumbe, located in the province Bas Congo, has been one of the key institutions to promote health and health education in the Congo. Dr. Jacques Courtejoie and his team are key players in promoting good health and in the production as well as distribution of educational material in the Congo. Actually they are one of the few functional institutes in this country developing and printing affordable health-promotion materials, including books on nutrition. This year 10 French enLINK trunks were provided by the Foundation to the Centre's library as well to some larger community health centres and hospitals in the Bas Congo.

ENLINK DIGITAL LIBRARY

After regular improvements and updates of the enLINK library, the user numbers of the library have increased continuously, reaching 252 registered users at the end of 2014. The enLINK library is a welcomed information source for individual users as well as librarians in many low-income countries. Based on the user statistics, the enLINK library seems to have become a widely used and appreciated information source.



VISION

SUSTAINABLE INTENSIFICATION

NEW ASPECTS OF BREASTFEEDING

MALNUTRITION: WHAT CAN WE DO?

APPLIED NUTRITION

LINEAR PROGRAMMING

During all the years, the Foundation has pursued a food-based approach to reduce malnutrition. In agreement with this strategy, Gordon Conway outlines the basic concepts of the sustainable intensification approach in agriculture, an approach for optimizing the agricultural output by optimized usage of all available resources. This strategy is very promising also at the level of "family farming", where food is produced locally for local consumption. In the same line, Allan Walker offers new evidence for the "intensification" of breast feeding—the basic nutrition

for health and well-being in later life. Similarly, our council member Walter Wahli underlines food adequacy for optimal epigenetics. Tu Ngu recalls the concept of "applied nutrition", which was developed to successful functionality by the Vietnamese soldiers and transferred to the population in Vietnam. Finally, one of our grant recipients, Umi Fahmida, tells us how "linear programming" can be used to choose the right food to avoid nutrient deficiencies. All articles underscore that "intensification" of a food-based approach still bears significant potential.

impair growth, mental development and immunity to diseases are common in both adults and children in many sub-Saharan countries. In the Democratic Republic of Congo, for example, vitamin-A deficiency in children under five is as high as 61 per cent, higher still for iron deficiencies, which are estimated to affect 71 per cent of children under five.

When it comes to finding solutions, I believe there is a practical pathway that can not only catalyse economic growth and improve the livelihoods of Africa's millions of smallholder farmers, but also achieve food and nutrition security for the continent. This pathway is sustainable intensification.

What is Sustainable Intensification?

A rapidly growing population, increasing demand for nutritious foods including livestock products, and the urgent need to address alarming levels of hunger and malnutrition, all require a response in which food production is intensified. Yet scarcities in resources such as land, water and soil fertility make this a challenge. "Sustainable Intensification" (SI) is an approach that ensures this increased food production has less impact on the environment, requires fewer inputs such as land and water, and ensures the natural resource base upon which agriculture depends is sustained, and indeed improved, for future generations.

The 2012 Montpellier Panel report "Sustainable Intensification: A New Paradigm for African Agriculture" explores the three pillars of SI—genetic, ecological and socio-economic—and demonstrates that SI could hold the key to improved production, income and nutrition in sub-Saharan Africa.

Genetic Intensification to Improve the Nutritional Quality of Food

Genetic intensification, for example, can involve the dissemination of new varieties of staple crops, or breeds of livestock with improved nutritive value. HarvestPlus is carrying out exemplary work on fortifying staple foods with vitamins and micronutrients. In Rwanda, ten new bean varieties that are richer in iron have been released in the country since 2011, in order to improve nutrition. By the end of 2013, some 700,000 farmers were growing these iron beans, which provide up to 45 per cent of daily iron needs.

In Kenya, Dr. Sheila Ommeh is researching how to breed a chicken that is disease-resistant, weighs around 4 kilograms and produces 250 eggs a year—about three times the weight and yield of indigenous chickens. This improved chicken could have a profound impact on the nutrition of rural families that rely on livestock for their daily meals.

SUSTAINABLE INTENSIFICATION FOR FOOD SECURITY AND HEALTH IN AFRICA

Africa's food and farming sector received renewed attention in 2014, as the African Union designated it the "Year of Agriculture and Food Security." Yet it is not only the quantity of food available that has been under scrutiny, but also the nutritional quality of this food. Indeed, "food and nutrition security" has now become the new norm.

The burden of malnutrition in Africa weighs heavily on the continent's population. Forty per cent of children suffer stunted growth as a result of inadequate nutrition. Deficiencies in vitamin A, zinc and iron that

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Ecological Intensification can Help to Diversify Diets

Another approach to SI is ecological intensification. Ecological processes, such as mutualism between crop plants, the destruction of pests by their natural enemies, and the microbial decay of organic matter can be sustainably intensified. To reduce the competition between crops, intercropping utilizes the mutually beneficial relationships that arise when two or more crops are grown in association, either as mixtures or rotations.

Nutrition is not only dependent on higher vitamin and nutrient intake, but also on a more varied diet. Planting leguminous crops such as beans and groundnuts that naturally fix nitrogen into the soil and improve nitrogen uptake improves plant growth, and planting crops amid leguminous *Faidherbia* trees that shed their leaves and provide nutritious mulch has also proved to make soil healthier. This in turn provides better harvests that can lead to higher incomes, alongside protein-rich and nutrient-dense crops to create healthier diets.

Families can also diversify their diets and provide a sustainable source of nutritious foods with home or kitchen gardens. These are rising in number in Niger, Somalia, Ghana and Kenya. As home gardens can house a variety of crops and livestock in one small area, improving the intricate relationships the crops and livestock have with one another can significantly boost production.

Organizations supporting the uptake of home gardens, such as the Food and Agriculture Organization (FAO) Nutrition and Consumer Protection Division, encourage the planting of spinach and other leafy vegetables, carrots, lentils and fruits, as well as keeping livestock such as chickens, goats, ducks and fish. Farm Africa, a UK-based charity, and its partners are also working to develop cropping of, and markets for, African indigenous vegetables (AIVs) in Tanzania and Kenya as important sources of nutrients and income.

Socio-economic Intensification can Improve Access to Food

Improving access to markets for staple crops as well as fruits and vegetables can help to improve a family's income and ability to buy a variety of foods that are not produced at home. If smallholder farmers and entrepreneurs along the agricultural value chain are supported with the right skills and finance to grow their businesses to take advantage of market opportunities, an intensified value chain can improve incomes. For example, SESACO Foods Company situated in Kampala, Uganda produces high-value nutritious foods made from maize millet, soybeans, groundnuts and sesame. With business development support from the Uganda

SUSTAINABLE INTENSIFICATION

Development Trust, SESACO upgraded their food-processing facilities, increased purchases from local farmers, hired additional staff and expanded sales to neighbouring countries, driving economic activity from the farm to the consumer.

Nutrient-dense Food Requires Fertile Soils

Food begins life in the soil and nutrient-poor soils will produce nutrient-poor crops. The latest report from the Montpellier Panel (a group of European and African experts that I chair), “No Ordinary Matter: Conserving, Restoring and Enhancing Africa’s Soils”, draws attention to the importance of soil to Africa’s food and nutrition security and economic growth. It is estimated that 65 per cent of Africa’s arable land is degraded. Poverty, climate change, population pressures and inadequate farming practices all lead to a continuous decline in the health of African soils, whilst the economic loss is estimated at USD 68 billion per year. Conversely, better land management practices could deliver up to USD 1.4 trillion globally in increased crop production—35 times the losses. Improved nutrition is one of the many goals for which Sustainable Intensification shows the way forward. A healthier population is not only more prosperous, but more productive. Producing more, higher quality foods with less and improving access to these foods are some of the greatest challenges we face globally. The adoption of Sustainable Intensification could make overcoming these challenges possible.





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NEW PROTECTIVE PROPERTIES AND FUNCTIONS OF BREAST MILK

General Breast Milk Protective Functions

It has been known for several decades that the ingestion of breast milk, particularly colostrum, provides the newborn infant with passive protection against the extruterine environment until its own defenses can develop. Protective factors in breast milk (pIgA, lactoferrin, lysozyme, etc.) are increased initially and then are reduced over the period of lactation as the newborn develops its own protective mucosal functions. What is less understood is how the newborn infant develops its own intestinal protection. It has been suggested that trophic

factors (hydrocortisone, transforming growth factor-beta [TGFβ], etc) ingested in amniotic fluid and early breast milk may stimulate the intestine to develop the capacity to establish intestine immune homeostasis. However, it has become recently apparent that the initial colonization process after birth is necessary to actually activate mucosal protective function.

Initial Bacterial Colonization and Host Defense

Over the last half century, the human disease burden in developed countries has shifted from predominantly infectious to immune-mediated diseases (allergies and autoimmune disease [type 1 diabetes, celiac disease, inflammatory bowel disease]). This has been principally due to public health measures (vaccination, use of antibiotics and a cleaner environment) that are a part of the Western lifestyle, resulting in a striking decrease in microbiota that initially colonize the newborn intestine. Disruption of initial colonization caused by cesarean section, perinatal use of antibiotics, or dysbiosis, for example, has a short-and long-term effect on mucosal immune health, resulting in a failure to achieve immune homeostasis and an increased propensity to express allergy and other immune-mediated diseases. Extensive basic and clinical investigation has revealed the importance of a diverse intestinal microbiota in innate and adaptive immune responses. This is particularly true at the time of neonatal development of intestinal host defenses. Recently, clinical studies have underscored the importance of diet as an environmental determinant of intestinal colonization. For example, the microbiota of African children, ingesting a high-fiber diet without animal fat and protein, is strikingly different from European children ingesting a predominantly Western diet (processed foods with high saturated fatty acids), as is their respective disease burden. Diet as an environmental determinant of intestinal microbiota is particularly important in the newborn period when colonizing bacteria has a profound effect on the development of host defense.

Breastfeeding and Intestinal Colonization

It is currently accepted that exclusive breastfeeding of newborn infants has a profound effect on the initial colonization of the gut. Not only are diverse microbiologic phyla (large families of bacteria) stimulated, but in the first few weeks of life specific health-promoting species (*Bifidobacteria*, *Lactobacillus* and *Bacteroides*) appear in the infant's intestine. These specific bacteria have been shown to stimulate development of the infant's own host defenses, including the secretion of polymeric IgA antibodies, and reduction in the inflammatory response, e.g., increase in inflammatory cytokines

(IL-8, IL-6), in clinical studies. In addition, specific neonatal bacterial species stimulate an increase in T-regulatory lymphocytes and their cytokines (IL-10 and TGF-β) to contribute intestinal immune homeostasis. How is the active stimulation of intestinal immunity accomplished by breastfeeding? Several recent studies have helped to illuminate this process. Breast milk, particularly colostrum, provides a large portion of its nutrient content as non-digestible oligosaccharides (8% of total nutrients). These unabsorbed oligosaccharides enter the colon undigested and act as substrate for bacteria fermentation, resulting in an intraluminal acid milieu and increased short-chain fatty acids (lactate, acetate, propionic acid and butyrate). The acid milieu environment facilitates the proliferation of health-promoting bacteria and the short-chain fatty acid specifically affects T-regulatory cells through receptors on their surface leading to immune homeostasis. It has been shown that breast milk oligosaccharides used as the sole source of carbon for *Bifidobacteria infantis*, a neonatal health-promoting bacterium, not only preferentially increases proliferation of this bacterium but also stimulates its specific bacterial genes which control enterocyte type junctions and anti-inflammation. This same proliferation does not occur when infants are fed formula. These observations underscore the importance of breastfeeding in establishing an appropriate colonizing microbiota and its effect on normal mucosal immune defense, an important protective intestinal function.

The Breast Milk Microbiome

Until recently it was assumed that breast milk was sterile and affected development of intestinal host defense principally through its indirect passive effects on indigenous colonizing bacteria. However, several studies over the last decade suggest that a specific bacterial microbiome exists in breast milk itself. This breast milk microbiome is not just contamination by microbiota on the mother's skin surrounding the areola and nipple or microbiota in the infant's mouth, but appears to be representative of maternal gut microbiota. Animal studies have shown that maternal gut microbiota can cross an increasingly permeable gut barrier, become engulfed by macrophages and lymphocytes and then migrate to the mammary gland, where the microbes are deposited into breast milk. These observations have been partially confirmed with limited human studies showing increased intestinal permeability to microbiota and circulating human blood macrophages within engulfed bacteria. The number of bacteria in breast milk (10^3 per cc) is considerably less than intestinal colonizing bacteria (10^{14} per cc) and the role of breast milk microbiota in the establishment of the newborn intestine's microbiome remains to be established. However, it is

exciting to speculate that health-promoting bacteria in breast milk with its bacterial proliferating components may be another factor in the development of newborn protection against possible disease states in the newborn environment as a result of initial colonization.

Summary

Breast milk has been considered to provide important passive protective properties for the newborn to adjust to the extrauterine environment. We have recently begun to appreciate its role in activating the newborn's own intestinal defenses. This development of intestinal host defense leading to homeostasis is in large part mediated by the initial bacterial colonization process. Breastfeeding is the most important environmental stimulus to an appropriate initial colonization of the gut.





MALNUTRITION: WHAT CAN WE DO?

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FORTY PERCENT OF THE WORLD POPULATION IS MALNOURISHED: WHAT CAN WE DO ABOUT IT?

In 2010, for the first time in our human history, there were equal numbers of overweight and underweight, malnourished people. Unfortunately, this was not the result of a reduction of hunger; rather, it was due to the dramatic increase in overweight individuals. Between 1980 and 2013, the number of overweight people rose from 857 million to 2.1 billion. This is more than the total world population in 1927, the year it first reached 2 billion. During the same period, the number of underweight people changed very little, with 98% living in low-income and middle-income countries (LMICs). Taken together, close to 40% of

today's world population is malnourished and suffers from a deficiency or an excess of the nutrients needed for healthy living. These malnourished people share high levels of illnesses, disabilities, shorter life spans, and reduced productivity, and represent the biggest public health problem humanity has ever faced.

Undernutrition is prevalent in LMICs and affects mothers and children primarily. It is responsible for over a third of child deaths and causes 11% of the global disease burden. In contrast, more adults in high-income countries (HICs) are overweight; however, it is becoming more and more prevalent in the urban populations of LMICs, which now have to face the double burden of under- and overnutrition. There is an alarming increase of overweight children, and this rate has nearly tripled over the last 30 years. As with undernutrition, it is imperative to address maternal and child overnutrition. How will this epidemic impact the future health of these obese children and public health in general? The earlier you are exposed to obesity, the earlier the onset of complications—including type 2 diabetes, cardiovascular disease, metabolic syndrome, and cancer—may occur. Similarly, the undernutrition of mothers is associated with poor fetal growth, and malnutrition in the first years of life leads to irreversible damage with respect to growth, level of schooling, and later chronic diseases. It does not come as a surprise that children's maturing bodies are especially vulnerable to the detrimental health effects of malnutrition. It is the irreversibility of these impairments that is particularly alarming. Even though it might appear shocking to address undernutrition and overnutrition at the same level, it is the poorest populations that are most affected in both situations. Further parallels include the impact on public health and the economic burden.

Extraordinarily, we know today that the health of the grandchildren of women who were malnourished during their pregnancy can be affected. How can deleterious effects of malnutrition in pregnant mothers be passed on to subsequent generations and affect their children's children? Obviously, a better understanding of the causes of the long-term and sometimes irreversible effects of malnutrition is needed to develop better interventions against it. This transgenerational influence of biologically imprinted environmental changes is recognized by scientists as an epigenetic effect in action. These observed modifications cannot be explained by changes at the level of the genetic code, but are the result of epigenetic alterations. These changes consist of the addition or removal of chemical groups on genetic material or on the histone proteins surrounding it. The genes themselves are not altered, but the gene activity is. Although these epigenetic modifications are usually reversible, some can be passed on to the next generation,

which explains why a child's genes can carry traces of malnutrition that affected a grandmother. Thus, the fight against malnutrition must adapt to the effects of epigenetic inheritance to better manage the targeted populations. Nutritional interventions aimed at saving the lives of children in the short term are not enough. They must also focus on reducing the risk of developing very serious diseases later on, and of passing on epigenetic anchored predispositions to future children. It is unclear how long it will take to develop approaches that will address epigenetic programming, but they are indispensable for promoting the long-term health of the beneficiaries and their offspring.

Tremendous advances have been made in understanding our genetic heritage. During our long natural history, hundreds of genes have been subject to positive selection, often in response to nutrition and diverse human activities. In Africa, the genome of humans was shaped by nutrient-gene interactions. On their exit from Africa 50,000 years ago, humans spread over the whole globe, facing new environments and challenges, some of which were imposed by nature, such as an ice age. Other, more numerous changes were self-imposed, including the domestication of animals and plants and changes in political organization, and were imposed by increases in population densities and sedentary life. These cultural changes represent some of the many modifications in human selection that have impacted our genome. An illustrative example is the spreading of the lactose-tolerance allele to high frequencies in less than 9,000 years in European, African, and Middle Eastern dairying populations. This conferred an advantage to people able to digest lactose, the main sugar in milk. Similarly, it is thought that during their conquest of the Pacific, the ancestors of present-day Polynesians were subject to starvation and cold stress during their long open-ocean journeys. Selection of an allele of the peroxisome proliferator-activated receptor gamma coactivator 1-alpha, which confers higher energy efficiency, represented an advantage at that time, but it is now associated with increased type 2 diabetes susceptibility in present-day Polynesians.

Today's human populations will respond differently to nutritional interventions based on their cultural history and ethnic background. Nutritional programs will have to adapt as we gain knowledge of nutrition-gene interactions. As with clothing, one size does not fit all! We need to determine the best nutrition that confers long-term transgenerational benefits, particularly for women of reproductive age, pregnant women, and young children in different parts of the globe. This aim may not be fulfilled for several years; yet, powerful technologies will continue to develop and generate new knowledge that will contribute to this goal.

Perhaps the biggest challenge in the field of nutrition is how to translate the rapid growth in biomedical and genetic/epigenetic knowledge into foods that can be made available to those who need them most, often in remote rural areas. First, there is a need for educational and research efforts on nutrition in LMICs, as well as in HICs, to improve nutritional literacy. Recent developments in information technology could help tremendously. The emergence of Massive Open Online Courses (MOOCs) provides top-level university courses for free to large numbers of students. Thus, lower-cost and high-quality education can be made available to disfavored groups, which often co-localize with populations in need of better nutrition. Larger groups of people will be able to promote research to develop locally-based solutions wherever possible, including the promotion of nutrition literacy to community health workers via outpost health centers. However, this will not be sufficient. The international nutrition system will also have to better integrate the joint efforts of academia, research, civil society, private sector, and donor organizations to implement global programs backed by sound national policies and requiring solid local political support.





THE ROOTS OF APPLIED NUTRITION IN VIETNAM: FROM THE ARMY TO THE POPULATION

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Talking about nutrition in Vietnam, we will never forget the contributions of Professor Tu Giay, an eminent Vietnamese nutritionist. Initially he tackled the problem of keeping Vietnamese soldiers nutritious and healthy, and later this knowledge was transferred and applied to the whole population. He was the founding director of the Vietnam National Institute of Nutrition, and the Vietnam Nutrition Association, and he established the farming system known as “VAC”, which provides food and nutrition to feed the army and also the population nationwide.

Professor Tu Giay was born in a village on the banks of the Red River. He experienced a difficult life in his youth, growing up in a poor family, but thanks to his hard-working mother and his own cleverness and willpower he achieved a high educational level. During wartime he worked in the Vietnamese Popular Army as a hygienist-nutritionist. In 1946, the resistance broke out in the whole country. The Resistance Army and people had to leave the cities and towns for the struggle waged in the countryside and mountainous areas, and they faced great challenges. Malaria, hunger, vitamin deficiency, and diseases associated with lack of hygiene in feeding (such as cholera, dysentery, and typhoid fever) were rampant. Thus nutrition and food hygiene as well as key public health issues became a central topic to ensure the health of the People's and Army Resistance. Under Professor Giay's guidance, the magazine *Enjoy Life* popularized to the soldiers and people a healthy lifestyle, basic knowledge of hygiene, sound nutrition, and strategies to control malaria—the most important health problems of that time. He participated in the battle at Dien Bien Phu in 1954. He instituted an emphasis on proper hygiene, with twelve specific recommendations for individual and collective hygiene, which was adopted for application across the entire army. Among the twelve hygiene issues, seven are related to meal hygiene, namely washing one's hands before a meal, cutting fingernails short, protecting food from flies, not drinking unboiled water, using two pairs of chopsticks or alternatively the two ends of chopsticks to pick up food and push rice into the mouth during a meal, not spoiling the water source, and completely filling the septic hole after use. This hygiene discipline helped to ensure that the soldiers remained healthy, and laid the basis for the victory at the Dien Bien Phu battle. This key knowledge implemented in the army then trickled down to the population.

In the war, the opposite side concentrated their attacks on the northern areas of the country, on the supply route from North to South—the Ho Chi Minh Trail—on logistic stations of battlefields, and on blocking the transfer of cereals and food from the provisionally occupied to the liberated zones.

The key question at that time was how to ensure the transportation of supplies, which urged the solution of a host of complicated problems. With colleagues, Professor Giay carried out research which helped distribute food to the battlefields where no rice or any other food could be produced or bought. One well-known solution was the “four-bag rice-packing” strategy. Rice was a staple food, and 500g of rice was the minimum daily ration for the soldiers. But unhusked and ground rice in bags could be preserved for only six months on average, after which it was spoilt by worms and insects. In addition, rain water

during transportation or storage was a permanent risk. The question was how to transfer rice from the North to support the soldiers and population in the South. His group, in coordination with experts, managed to find the solution in using “hermetic rice packing”. Rice transported to the battlefield was packed in four bags: the innermost bag was made of hemp as for common rice bags; covering it outside was a polyester bag, protecting rice from the chloride smell emanating from the outer, third, PVC bag that prevented humidity; and the outermost bag was again of hemp and protected against shock and tears. Rice packed this way could last two to three years if properly preserved. Rainwater could not dampen it, and the quality of the rice was well preserved in underground caches, undamaged by the enemy or the toxic chemicals reported from several battlefields. During the Quang Tri campaign, rice bags were dropped at the higher section of the Thach Han River for our army to pick up at the lower section of the river. During the enemy blockade of our point, the rice bags floated on the sea and were brought ashore by the rising tide. “Four-bag rice packing” was also the basis of improved rice and food storage strategies for the population.

Another of their useful research approaches and finally solutions was the utilization of edible wild vegetables. Vietnam started to solve the problem of the lack of vegetables during military operations by processing dried vegetables, dried white radish, and dried water morning-glory. Once more, difficulties in transportation made the supply of green vegetables impossible. We tried to convey green beans to army units for their soaking into sprouts, but a continuous catering of green beans to all army units was impossible. The best solution was to promote local self-producing of green vegetables among army units. On the high plateaux of Vietnam, water is scarce during the dry season. We had a law in the army that waste water be saved, so we could grow some drought-resistant vegetables. This law helped a number of high-plateaux army units to partially resolve the problem of green vegetable consumption in the dry season. Further, six botany study groups gathered 420 species of wild edible vegetables, printed their pictures, organized documentation, and trained all officers and soldiers as well as civilians in harvesting wild vegetables. Certain units in their yearly reports calculated they had collected hundreds of tons of wild vegetables, with the minimum consumption average of 100 g per capita/day. Those rice bags and edible wild vegetables contributed to preventing and treating two common diseases that caused notable loss in the battlefield during the first years of war in South Vietnam: beriberi and night-blindness. Also, this knowledge was transferred to the local population and slowly better health evolved thanks to locally implemented knowledge.

rather theoretical approach. In Vietnam the VAC system is functional and it can only be hoped that this concept will survive the globalization of food and lifestyle.

After the war, Dr. Tu Giay became Director of the National Research Program to improve the nutritional status of the Vietnamese people. Among the ten state-focused studies, along with major problems such as energy, communication, and the exploitation of the Red River and Mekong deltas and High Plateaux, one goal was to improve meal constituents. As a result of these activities, the National Institute of Nutrition was established in 1980. Giay was the founder and the first director of this Institute (1981-1993). Under his direction, the Institute has contributed remarkably to the nutrition program in Vietnam. With his reputation and experience, he arranged for government support and international cooperation to train staff and undertake major projects to help improve the nutritional status of people in that very difficult time.

Prof. Tu Giay is the initiator of the "VAC" movement (VAC: garden, fish-pond, animal husbandry) now widely accepted and expanded through the whole country. VAC is an integrated farming system in which gardening, animal husbandry, and water food culture are combined to yield the best results, and all the potentials available are fully used in a wise manner and residues are also recycled for use. The VAC system has a scientific basis in previous experience and energy-saving as well as waste-recycling strategies. The VAC system helps to increase income, improve the environment, and provide good food, thus improving health and nutrition. It was clear in Vietnam that as the VAC system was providing encouraging results, it could help farmers lead a better life, stabilize their rural social conditions, and keep them from having to trek to the cities. The Vietnamese Gardeners' Association (VACVINA - VAC Vietnam) was set up in 1988, and today the Association has branches in all provinces and cities of the country. It has held many training courses to help its members create their own local Eco-VAC systems. Many Vietnamese families have overcome hunger and poverty with the VAC system. It is a long-term intervention that is now used to improve the nutritional status of people in other countries as well, and even the Food and Agriculture Organization of the UN adopted many aspects of the VAC system in their strategies to globally reduce malnutrition.

Tu Giay was a very sociable person, eager to learn. He appreciated and knew how to apply the experience of the old people and the help of international friends to adapt applied nutrition to the Vietnamese situation. He was a pioneer in the field of applied nutrition and primary health care. He enhanced the role of locally available foods in nutritional interventions to improve the health of the people. He was an active promoter of nutrition knowledge among the population, and the socialization of health services received ardent support from him and his colleagues. Today the global nutrition community promotes "community-based food and nutrition programs" using often a





LINEAR PROGRAMMING

LINEAR PROGRAMMING TO IMPROVE MATERNAL AND CHILD NUTRITION AND HEALTH

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Jakarta, Indonesia

The world population hit 7 billion in 2011 and is expected to reach 10 billion in the year 2050. While increasing population demands for more food and food security become ever more important, quality food nonetheless remains the critical issue as the consequences of poor diet, especially in pregnant women, infant and young children, are enormous. A food-based dietary guideline (FBDG) which is compatible with food supply, environmentally sustainable and addresses the potential nutritional problems in a specific population is therefore necessary given the diversity across the world in these aspects.

FBDGs, including complementary food recommendations (CFR) for children less than two years of age, and food-based recommendations (FBR) for other age groups are often designed through expert committees meeting at the country level. The process involved includes the committee's drafting the FBDGs based on data regarding nutrition-related diseases, food availability and intake patterns, and then having relevant interest groups review the FBDG prior to its socialization to the community. More recently, an approach called linear/goal programming (LP) has been introduced to develop and evaluate FBRs. This LP approach offers advantages compared to the conventional approach in terms of time, objectivity and strength of evidence upon which to base decisions on the final FBRs (1).

What is LP?

LP is a mathematical modelling approach which can identify an optimal diet, i.e. one that can fulfill as many as possible of the nutrient requirements ("GOALS") while simultaneously taking into account multiple variables including local food availability, food patterns, food portions, food cost, food affordability and the diet's energy content ("CONSTRAINTS") (1-2).

What can one achieve with LP?

LP can be used to formulate and evaluate FBRs. Using LP one can identify what nutrient(s) is/are problem nutrient(s) in a specific community and can categorize whether the problem nutrients are partial or absolute problem nutrients. A "partial problem nutrient" is a nutrient for which the requirement can be achieved in a diet using local foods, but to the detriment of achieving the requirement of at least one other nutrient. On the other hand, an "absolute problem nutrient" is a nutrient for which the requirement cannot be achieved using local foods unless there is a change in food availability and food pattern (2). This provides useful information on other necessary complementary interventions, including agriculture intervention to add or increase local produce rich in that particular nutrient, a behavior-based approach to encourage expanding the food basket of a particular age group, or a fortification program.

LP is a powerful tool to identify nutrient-rich foods and the extent to which these foods can fill the gap in the problem nutrients. In the area where a certain micronutrient deficiency is prevalent, there may be food resources which have not been utilized to the full extent possible. In our recent work in Indonesia and Myanmar, for example, LP has been used to show how much intake of the problem nutrients can be contributed by moringa (drumstick leaf) and roselle leaf, respectively. One can also use LP to simulate alternative combinations of food-based approaches such as naturally occurring nutrient-dense foods and manufactured fortified foods (3), or to identify the

optimal frequency of home fortification when diet has been optimized. As a CFR/FBR developed using LP is compatible with local food patterns, the chance of its successful adoption and sustainable practice is greater. We have observed good compliance to the CFR in an intervention study to promote consumption of chicken liver, fish and anchovy as iron-, zinc- and calcium-rich foods in Lombok, Indonesia (4).

How can we apply LP?

LP requires reliable data on food availability, food patterns, portion sizes and nutrient composition from the food composition table. The cost of available foods and how much is affordable for the community ideally should also be collected through market surveys and group discussion. In our previous studies, (4,5) also supported by the Nestlé Foundation, we used a 1-day weighed diet record to come up with accurate portion sizes, and combined that with 1-day 24-hour dietary recall and a 5-day food tally in order to come up with a 7-day food pattern. Alternatively, when only 1-day 24-hour recall data is available, such as when analyzing results from the national survey data of Indonesia (2), we have used a method to determine the maximum number of servings per week, for individual foods, from the percentage of children who consumed them by using the distribution of a sum of binomial random variables (6).

LP analysis can be performed using linear optimization (Excel's solver function) in Microsoft Excel (7) and in Optifood software (8). Several alternative sets of CFRs to be tested are those in which the food groups in the nutritional optimal LP diet had a higher number of servings per week than the observed median number of servings per week for the population. The final CFR/FBR may also include individual foods (or their equivalent food sub-group) that, in the nutritional optimal LP diet, contributed at least 5% of the problem nutrients. Alternative sets of these individual CFRs/FBRs are then tested and compared on the basis of their minimized nutrient content and a final set of CFRs is selected that ensures at least 70% of the FAO/WHO recommended nutrient intake (RNI) (9) for most nutrients. Once an optimal CFR is identified and pilot tested, feedback from the pilot test can also be incorporated into LP for further refinement of the recommendations.

Future expectation

Given the usefulness of LP, it will play an important role in improving the nutritional status of impoverished populations especially in low-resource settings. We expect more innovations on LP application to improve maternal and child nutrition and health in the future.



PROFILE OF A NUTRITION INSTITUTE



Cyprian Katongo, PhD

Department of Biological Sciences
University of Zambia

Lusaka
Zambia

The University of Zambia, located in Lusaka, is the highest-ranked university in Zambia. It has a student population of about 25,000. There are eight different public universities in Zambia, together offering more than 150 degree and postgraduate courses. The University of Zambia in Lusaka has nine faculties, among which is the School of Natural Sciences, which houses the Department of Biological Sciences. There is no national nutrition institute and also no Department or Institute of Nutrition per se at the University of Zambia. However, there is some work being done in the Department of Food Science and Technology in the School of Agricultural Sciences, in the Faculty of Medicine, and in the Departments of Biological Sciences and Chemistry in the School of Natural Sciences. In addition, public health nutrition-related activities are pursued in different departments of the Ministry of Health. All these different players collaborate closely.

In the Department of Biological Sciences, work on human nutrition is spearheaded by Dr. Cyprian Katongo, Senior Lecturer and Head of Department. Dr. Katongo has been working in collaboration with other colleagues within the University of Zambia, mainly from the Department of Crop Science in the Faculty of Agriculture, where new varieties of beans (*Phaseola vulgaris*) being produced through mutation breeding (through irradiation) are being evaluated for disease and drought resistance. Other colleagues from the Department of Chemistry in the School of Natural Sciences are assessing the nutrition value of these new varieties of beans. In addition, the Department of Food Science and Technology in the School of Agricultural Sciences offers a BSc degree in Food Science and Technology in which subjects on human nutrition are taught.

ZAMBIA

AREA

Total: 752,614 km²
Arable land: 6.9%

POPULATION

Total: 15,021,002 (2014 est.)
Urban population: 39.5% (2010)
Under age 15: 46.9%
Median age: 17 years (male 16.9 years / female 17.2 years)
Net migration rate (per 1000): -1.4
Rate of urbanization: 4.5% annual rate of change (2014 est.)

POPULATION GROWTH RATE

Total: 2.8% (2010 est.)
Urban areas: 42% (2010 est.)
Total fertility rate: 5.7 children born/woman (2014 est.)

GNP (per capita): \$1,500 (2008 est.)

LIFE EXPECTANCY AT BIRTH

Total: 50.9 years
Male: 50.3 years / Female: 51.6 years

MORTALITY RATES

Births attended by skilled health personnel: 46% (2012)
Neonatal mortality rate (2010): 29/1000
Infant mortality rate at birth: 66.6/1000
Infant mortality rate (under 1): 56/1000 (2012)
Under-five mortality rate (2010): 89/1000
Under-five mortality rate, rank: 25
Maternal mortality rate (2010): 440/100,000 live births
Life expectancy at birth (2010): 50.9 years

INFANT AND YOUNG CHILD FEEDING

Six-month exclusive breastfeeding rate (2012): 61%
Early initiation of breastfeeding (2007-2011): 56%

Timely complementary feeding rate (6-9 months): 94%
Children who are still breastfeeding (12-23 months): 41%

KEY NUTRITIONAL ANTHROPOMETRY

Low Birth Weight: 11%
Underweight (moderate and severe): 15%
Stunting in children < 5 years: 45% (2012)
Prevalence of wasting (moderate and severe): 5% (2006-2010)

MICRONUTRIENT DEFICIENCIES

Percentage of households consuming iodized salt (2008-2012): 77%

OTHER PARAMETERS

Median age at first birth among women 25-29 (2007 est): 19.2
Birth registration (% urban / rural): 28% / 9%
Total adult literacy rate: 61.4%

Primary school net enrolment ratio (%), 2008-2011: 97%

% of population using improved sanitation facilities, 2012, total: 42.8%
% of population using improved sanitation facilities, 2012, urban: 55.8%

% of population using improved sanitation facilities, 2012, rural: 33.2%

% of population using improved drinking-water sources, 2012, total: 64%

Immunization 2011, 1-year-old children immunized against measles: 83%

Immunization 2011, 1-year-old children immunized against polio: 83%

Immunization 2011, 1-year-old children immunized against DPT: 78%

Antenatal care coverage (%), at least four visits (2007): 60%

Delivery care coverage (%), skilled attendant at birth (urban / rural): 83% / 31%

Physician density: 0.07/1,000

Our department is collaborating with colleagues from other institutions such as the Copperbelt University, where work is being carried out on the nutritional value of edible insects such as grasshoppers, termites and caterpillars. Another concerted research action is taking place with the Tropical Diseases Research Centre, where work on the vitamin-A and iron nutritional status of vulnerable children is being carried out. In addition, an important collaboration is with the National Food and Nutrition Commission of Zambia, which is the governmental promotional and advisory organ on matters concerning food and nutrition in Zambia, and whose focus is on children, pregnant women and lactating mothers.

Dr. Katongo's initial work started in 2008, when laboratory space was secured and the first project funded, a pilot study (supported by the Nestlé Foundation in 2010) which focussed on determining the iodine nutrition status baseline among pregnant women in areas of Zambia where the population is at high risk for iodine deficiency disorders (IDD). The districts included were Mpika, Kaputa and Kasempa, where local people produce and consume local salt which is not iodised. Before starting the pilot study, Dr. Katongo was trained in urinary salt iodine determination at the Nutritional Intervention Research Unit of the Medical Research Council of South Africa in Cape Town through a South-South collaboration which continues to be encouraged because it taps into the rich local knowledge and capacity. This training was also supported by the Nestlé Foundation. Urine and household salt samples from pregnant women from the three districts were analysed. Unfortunately, the results from urinary iodine analysis were not reliable because of contamination in the Biochemistry Laboratory of the Tropical Diseases Research Centre. However, the results from the market and household salt analysis were reliable and they revealed that there was inadequate iodine in the salt consumed in these districts.

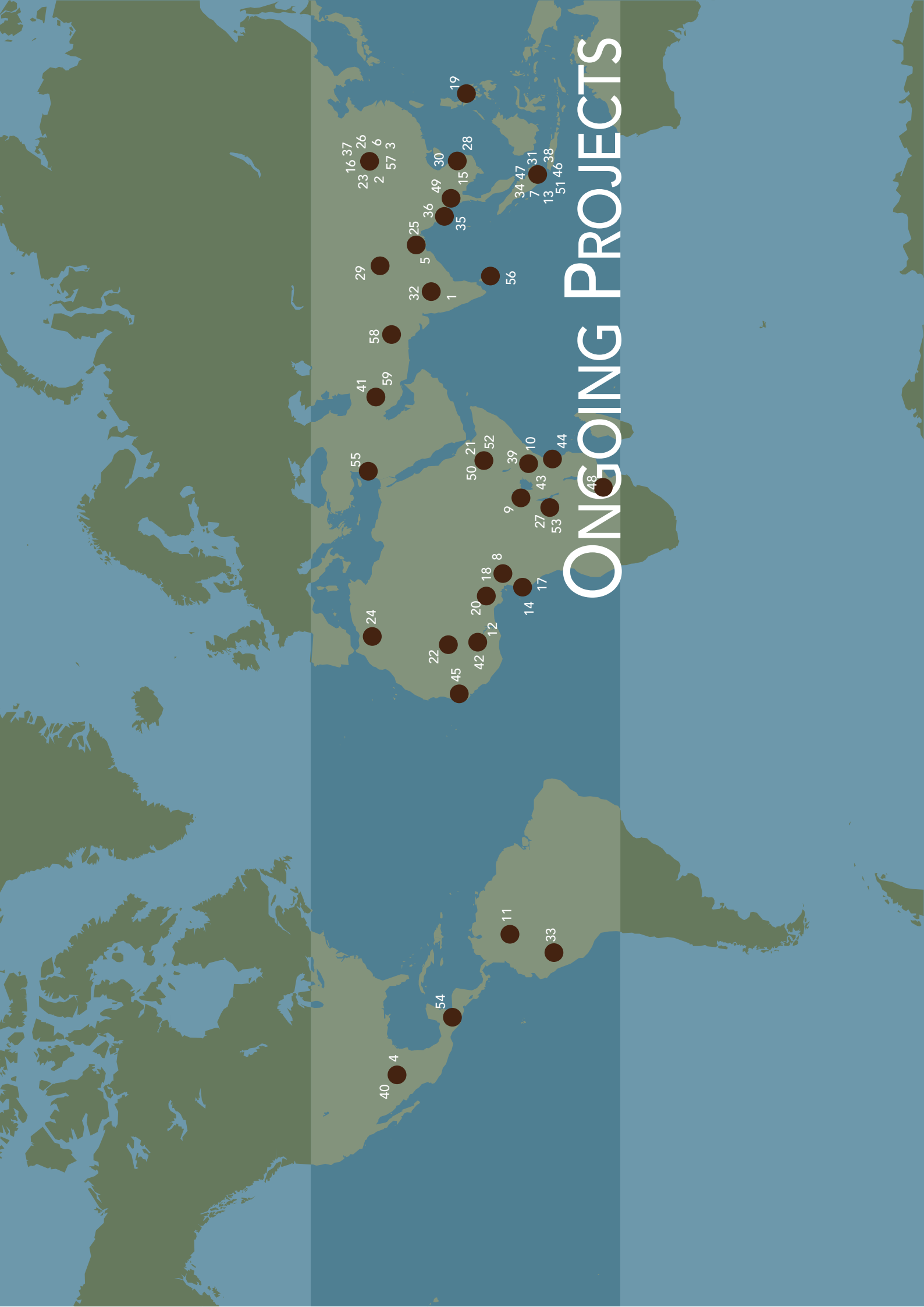
Later the group leader was involved in the 2011 National IDD Survey for Zambia on behalf of the National Food and Nutrition Commission of the Ministry of Health with the support of USAID and UNICEF. This survey was based on school-going children who were drawn from a 30-school sample from all 10 provinces of Zambia. Both urine and household salt samples were analysed for iodine content. The overall results indicated adequate iodine nutrition among the school-going children of Zambia, but the results for Kasempa and Kaputa showed that the children in these two districts were not getting enough iodine in their salt and were at risk of IDD. The urinary iodine concentration in this survey was carried out at the Tanzania Food and Nutrition Commission in Dar-es-Salaam in Tanzania while the salt iodine determination was carried out at the Food and Drug Control Laboratory in Lusaka, Zambia. Once

more a very productive and rewarding South-South collaboration. The Department of Biological Sciences' aims in the field of nutrition in the near future are in the following areas, with well-defined objectives:

- (i) Monitoring the IDD prevalence in Zambian women and children under the age of five using urinary iodine concentration as a proxy with a view to help reduce the prevalence to WHO acceptable levels. The group is also interested in determining the adequacy of salt iodisation, packaging and storage with a view to help ensure adequate salt iodisation, proper salt packaging and proper salt storage.
- (ii) Monitoring vitamin A nutrition status among primary-school children with the view to ensure adequate vitamin A intake.
- (iii) Monitoring iron nutrition status among primary-school children with the view to ensure adequate iron intake.
- (iv) Monitoring the amount of vitamin C and essential minerals in common foods on the Zambian market to ensure adequate access to vitamins and essential elements.
- (v) Monitoring the nutrition status of vulnerable pregnant and lactating mothers to ensure their health and that of their children and unborn children.

In order to achieve the objectives stated above, the group in our department in 2012 embarked on setting up a nutrition laboratory in the Department of Biological Sciences, and the new laboratory is so far equipped with a state-of-the-art spectrophotometer and related equipment for the analysis of food samples as well as human blood and urine specimens. It is hoped that soon a National Nutrition Institute will be set up in Zambia, especially at the University of Zambia to consolidate nutrition research and intervention in Zambia aimed at improved nutrition among the people of Zambia.





ONGOING PROJECTS



TITLE

PRINCIPAL INVESTIGATOR

INFANT AND CHILD NUTRITION

TITLE

PRINCIPAL INVESTIGATOR



- 1 2007 / Iodine supplementation in mildly-to-moderately iodine-deficient, pregnant women: Effects on pregnancy outcome and infant development
Sumitra Muthayya
St John's National Academy of Health Sciences, Institute of Population Health and Clinical Research, Bangalore, India
- 2 2008 / Improving micronutrient status of Chinese children using dietary spirulina
Shi-an Yin
National Institute of Nutrition and Food Safety, Beijing, China
- 3 2008 / Effects of vitamin A supplementation during lactation on infants' antibody response to hepatitis B vaccine in China
Zhixu Wang
Nanjing Medical University, School of Public Health, Nanjing, China
- 4 2008 / Impact of vitamin A and zinc supplementation on pathogen-specific diarrheal disease in Mexican children
Kurt Long
University of Queensland, Division of International and Indigenous Health, Brisbane, Australia
- 5 2009 / Effect of maternal zinc supplementation during pregnancy and lactation on infants' immunity
Mohammad Bakhtiar Hossain
ICDDR, B, Clinical Research Division, Mohakhali-Dhaka, Bangladesh
- 6 2011 / Effect of soybean supplementation, parasite control and nutrition education on iron status of adolescent girls in rural China
Lei Li
Medical College of Xiamen University, Siming District, Xiamen, China
- 7 2014 / Minimizing the negative effect of iron supplementation and fortification on gut microbiota using local resources
Siti Helmyati
Gadjah Mada University, School of Health and Nutrition, Faculty of Medicine, Yogyakarta, Indonesia
- 8 2008 / Information and education to support and promote exclusive breastfeeding
Ada C Uwaegebute
Michael Okpara University of Agriculture, Umuahia, Nigeria

- 9 2007 / Potential of amaranth grain seeds to improve the nutrition and health status of school children
John Muyonga
Makerere University, Department of Food Science and Technology, Kampala, Uganda
- 10 2007 / Improving nutritional status of children aged 6-18 months in a semi-arid area in Kenya: The potential of amaranth seed flour
Alice Mbogani Mwangi
University of Nairobi, Applied Nutrition Programme, Uthiru-Nairobi, Kenya
- 11 2008 / Nutrition, anaemia, growth and oxygen weaning in low-birth-weight oxygen-dependent infants in a Kangaroo Clinic
Nathalie Charpak
The Kangaroo Foundation, Bogota, Colombia
- 12 2010 / Effect of fish meal and Vitamin C on the iron status of Ghanaian children consuming cowpea-based food
Godfred Egbi
University of Ghana, Noguchi Memorial Institute for Medical Research, Legon, Ghana
- 13 2010 / Intensive nutrition and hygiene education for improving nutrient intake of children (6-11 months)
Dwi Nastiti Iswarawanti
SEAMEO Regional Center for Food and Nutrition, Jakarta, Indonesia
- 14 2010 / Testing the efficacy of an audio program and discussion guide in promoting exclusive breastfeeding in Cameroon, Africa
Susanne Montgomery
Loma Linda University, School of Public Health, Loma Linda, California, USA
- 15 2010 / Efficacy of combined selenium and iron supplementation on micronutrient status of school children
Nguyen Van Nhien
National Institute for Food Control, Hanoi, Vietnam
- 16 2011 / Effect of hookworm elimination and vitamin A intervention on anaemic status of pre-school children in Sichuan, China (resubmission)
Ke Chen
Chengdu Maternal and Children's Health Care Hospital, Chengdu, Sichuan, China
- 17 2012 / Food-based approaches to reduce childhood nutrients-energy malnutrition in Bangang community, Cameroon
Marie Modestine Kana Sop
University of Douala, Faculty of Science, Douala, Cameroon
- 18 2012 / Drama for behaviour-change communication on breastfeeding and complementary feeding practices in rural areas of Osun State, Nigeria
Beatrice Olubukola Ogunba
Obafemi Awolowo University, Department of Family, Nutrition and Consumer Sciences, Ile Ife, Nigeria

MICRONUTRIENTS

BREASTFEEDING



MATERNAL NUTRITION

- 27 2010 / Urinary iodine concentration of pregnant women in Zambia as an indicator of their iodine nutrition status
Cyprian Katongo
Copperbelt University, School of Mathematics and Natural Sciences, Kitwe, Zambia
- 28 2010 / Pre-conceptional vs gestational food supplements and pregnancy outcomes in rural Vietnam
Tu Ngu
National Institute of Nutrition, Department of Applied Nutrition and Nutritional Surveillance at the National Institute of Nutrition, Hanoi, Vietnam
- 29 2011 / Assessment of iodine status in pregnant women and weaning infants in eastern region of Nepal
AK Nepal
Koirala Institute of Health Sciences, Department of Biochemistry, Kathmandu, Nepal
- 30 2013 / Impact of pre-pregnancy micronutrient supplementation on infant growth and development
Phuong Hong Nguyen
Thainguyen Medical School, Thainguyen, Vietnam

INFANT AND CHILD NUTRITION

- 19 2013 / Infant and young child feeding and care practices of caregivers in the Province of Albay, Philippines
Joyce Louise Cruz Ignacio
University of The Philippines Los Banos, College of Economics and Management, Laguna, Philippines
- 20 2013 / Formulation and characterization of infant flours using spirulina powder in replacement of multivitamin-mineral complex
Evariste Mltchikpe
University of Abomey Calavi, Department of Nutrition and Food Sciences, Cotonou, Benin
- 21 2014 / Effects of feeding style and fiber content of complementary foods on the appetite of Ethiopian infants
Kaleab Baye
Addis Ababa University, Center for Food Science and Nutrition, Addis Ababa, Ethiopia
- 22 2014 / Effect of personalized nutritional counselling on child growth and feeding practices in Burkina Faso
Yassinme Elysee Somasse
Polytechnic University of Bobo-Dioulasso, Department of Public Health, Bobo-Dioulasso, Burkina Faso

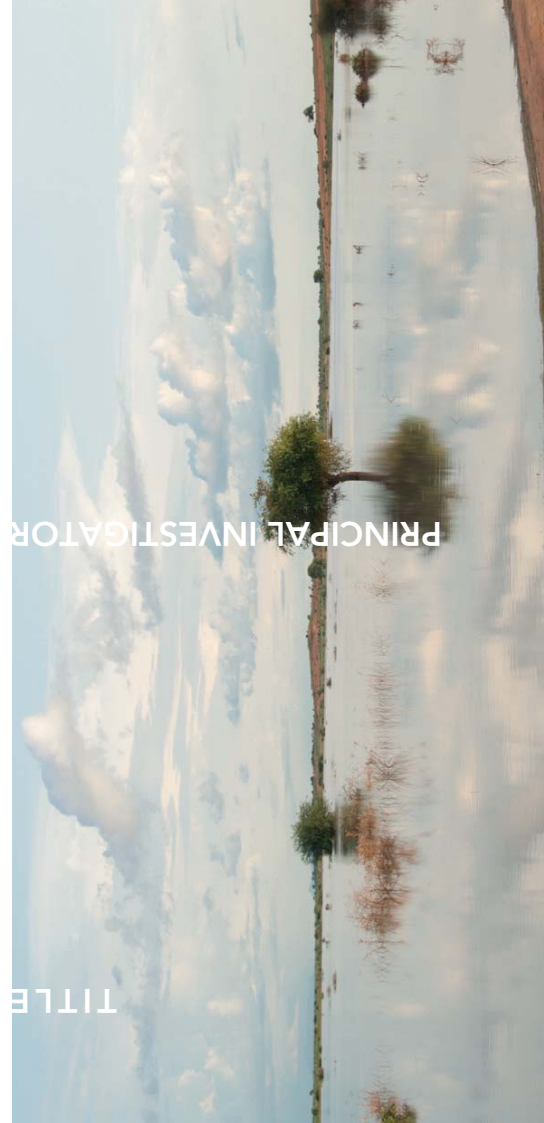
CHILD BEHAVIOURAL DEVELOPMENT

- 31 2009 / Food-based intervention and psychosocial stimulation to improve growth and development of <24mo Indonesian children
Umi Fahmida
University of Indonesia, SEAMEO RECFFON, Jakarta, Indonesia
- 32 2011 / Effects of maternal iodine supplementation in an area of mild iodine deficiency on infant development to 2 years (a follow-on study to our previous Nestlé Foundation grant)
K Srinivasan
St. John's Research Institute, Bangalore, India
- 33 2012 / Maternal zinc nutrition: Its influence on human health and development in Peruvian children
Nelly Zavaleta
Instituto de Investigacion Nutricional, Lima, Peru
- 34 2013 / Food-based intervention and psychosocial stimulation to improve child growth and development: First follow-up study
Umi Fahmida
University of Indonesia, SEAMEO RECFFON, Jakarta, Indonesia

MATERNAL NUTRITION

- 23 2008 / The development of new norms for indicators of iodine status during pregnancy and its impact on the prevalence of mental retardation in children
Chen Zupei
Tianjin Medical University, Institute of Endocrinology, Tianjin, China
- 24 2009 / Impact of daily consumption of vitamin-A-fortified oil on breast milk vitamin A concentration and vitamin A status of lactating Moroccan women
Najat Mokhtar
Ibn Tofail University, Nutrition Unit, Kenitra, Morocco
- 25 2009 / Role of vitamin B12 supplementation during pregnancy and postpartum to alleviate nutritional anaemia in Bangladeshi women and their infants
Towfida Jahan Siddiqua
ICDDR, B, Nutritional Biochemistry Lab, Dhaka, Bangladesh
- 26 2010 / SMS and web-based support for appropriate infant feeding to prevent childhood obesity in urban China
Hong Jiang
Fudan University, School of Public Health, Shanghai, China

PRINCIPAL INVESTIGATOR





PRINCIPAL INVESTIGATOR

IMMUNE DEFENSE

- 35 2010 / The role of sub-clinical inflammation on micronutrient status of Myanmar adolescent girls during micronutrient supplementation
Min Kyaw Htet
SEAMEO TROPMED Network, Jakarta, Indonesia
- 36 2011 / Exploration of Myanmar rural caregivers' concepts on childhood diarrheal disease (6-24 months) and its management related to ORS use and feeding
Khaing Mar Zaw
University of Indonesia, SEAMEO RECFON, Jakarta, Indonesia

EPIDEMIOLOGIC TRANSITION

- 37 2009 / A pilot study of school-based peer education and obesity-related behaviours in adolescents in Beijing, China
Zhaohui Cui
University of Sydney, The George Institute for International Health, Sydney, Australia

NUTRITION EDUCATION

- 38 2011 / A multi-approach intervention to empower posyandu nutrition program to combat the malnutrition problem in rural areas
Ali Khomsan
Bogor Agricultural University, Department of Community Nutrition, Bogor, Indonesia

FORGOTTEN CROPS / AGRICULTURE

- 39 2014 / The efficacy of biofortified pearl millet in a randomized controlled trial with children <2y in rural Eastern Kenya
Mueni Hellen Ndiku & Sabaté Joan
University of Eastern Africa, Baraton School of Science and Technology, Eldoret, Kenya
Loma Linda University, School of Public Health, Loma Linda, California, USA
- 40 2014 / Promoting food sovereignty through a cooperative model for sustainable organic farming in the Mayan Region, Mexico
Cristina Osorio-Vazquez
Universidad Intercultural Maya de Quintana Roo, Quintana Roo, Mexico

OTHER RESEARCH AREAS

- 41 2008 / Causes and control of food insecurity: A pilot model in the Northwest of Iran
Saeed Dasgiri
Tabriz University of Medical Sciences, Faculty of Medicine, Tabriz, Iran
- 42 2010 / Improving nutritional status of school-children through consumption of cowpea: A food sovereignty perspective
Abdul-Razak Abizari
School of Medicine and Health Sciences, Community Nutrition Department, Tamale, Ghana
- 43 2010 / Pilot study to assess the acceptability of pearl millet grain at macro- and micro-levels in rural Eastern Kenya
Mueni Hellen Ndiku
University of Eastern Africa, Baraton, School of Sciences and Technology and Department of Public Health, Eldoret, Kenya
- 44 2011 / Effectiveness of nutrition package in improving growth of rural children (6-23 months): A cluster randomised trial
Kissa B.M. Kulwa
Sokoine University of Agriculture, Department of Food Science and Technology, Morogoro, Tanzania
- 45 2012 / Prenatal and young child nutritional supplementation and early childhood body composition, growth and development
Momodou K Darboe
MRC International Nutrition Group, Banjul, Gambia



TITLE

PRINCIPAL INVESTIGATOR



PRINCIPAL INVESTIGATOR

OTHER RESEARCH AREAS

- 55 2013 / Healthy kitchens, healthy children: A school-based cluster randomized controlled trial
Nadine Sahyoun & Hala Ghattas
University of Maryland, Department of Nutrition and Food Science, College Park, Maryland, USA and American University of Beirut, Center for Research on Population and Health, Beirut, Lebanon
- 56 2013 / Nutrition and food security: Impact of soil fertility and productivity of home gardens on family nutrition (resubmission)
U R Sangakkara t, continued by Janaki Mohotti
University of Peradeniya, Faculty of Agriculture, Peradeniya, Sri Lanka
- 57 2013 / Study on effects of excess iodine and the tolerable upper intake level of iodine for children (Pilot study)
Wanqi Zhang
Tianjin Medical University, Public Health College, Tianjin, China
- 58 2014 / Nutrition gap map: A comprehensive mapping, quality assessment and summary of nutrition-relevant systematic reviews
Zulfiqar Ahmed Bhutta
Aga Khan University Hospital, Center of Excellence in Women and Child Health, Karachi, Pakistan
- 59 2014 / A cohort analysis of the sustainability of food insecurity control programs in the northwest of Iran
Saeed Dastgiri
Tabriz University of Medical Sciences, Faculty of Medicine, Tabriz, Iran

- 46 2012 / Optimized complementary feeding versus iron supplementation on micronutrient status and gut microbiota of children (resubmission)
Lwin Mar Hlaing
University of Indonesia, SEAMEO REC-FON, Jakarta, Indonesia
- 47 2012 / Effects of dietary/lifestyle counselling on risk of major cardiovascular events in CAD and non-CAD population in Indonesia (resubmission)
Iqbal M. Husein
Gadjah Mada University, School of Medicine, Makassar, Indonesia
- 48 2012 / Consumer acceptability of spirulina in Zimbabwe, and effect of cooking on spirulina provitamin A carotenoids
Tawanda Muzhingi
Tufts University, Avondale, Harare, Zimbabwe
- 49 2012 / Sustainable community-based diabetes prevention program by lifestyle modification for at-risk populations in Thailand
Kitti Sranacharoenpong
Mahidol University, Institute of Nutrition, Phuttamonthon, Thailand
- 50 2012 / Community salt iodization and relation of iodine intake to Visual Information Processing (VIP) of Ethiopian infants
G Tafere
Hawassa University, Human Nutrition, Hawassa, Ethiopia
- 51 2012 / Effect of nutrient-dense complementary food on catch-up growth of Indonesian moderately stunted children
Duma Octavia Fransisca
University of Indonesia, SEAMEO REC-FON, Jakarta, Indonesia
- 52 2013 / Child-centered counseling and home-based food production to improve dietary adequacy and growth of young children in southwestern Ethiopia
Abebe Gebremariam
Jimma University, Department of Population and Family Health, Jimma, Ethiopia
- 53 2013 / Assess the impact of public health services distribution of vitamin A in the under-five children in remote rural Zambia
Frederick D Kaona
University of Zambia, Mwengu Social and Health Research Center, Ndola, Zambia
- 54 2013 / Behavior change and nutrition associated with integrated maternal/child health, nutrition and agriculture program
Manolo Mazariagos
Institute of Nutrition of Central America and Panama (INCAP), Guatemala City, Guatemala

OTHER RESEARCH AREAS



PRINCIPAL INVESTIGATOR

PUBLICATIONS

- Diana R, Khomsan A, Sukandar D, Riyadi H. Nutrition extension and home garden intervention in Posyandu: Impact on nutrition knowledge, vegetable consumption and intake of vitamin A. *Pakistan J Nutr* 2014;13:88-92.
- Egbi G, Steiner-Asiedu M, Kwesi FS, Ayi I, Ofosu W, Setorglo J, Klobodu SS, Amars-Klemesu M. Anaemia among school children older than five years in the Volta Region of Ghana. *Pan Afr Med J* 2014;17 (suppl 1): 10.
- Fahmida U, Kolopaking R, Santika O, Sriani S, Umar J, Htet MK, Ferguson E. Effectiveness on improving knowledge, practices, and intakes of «key problem nutrients» of a complementary feeding intervention developed by using linear programming: experience in Lombok, Indonesia. *Am J Clin Nutr* 2014; First published ahead of print December 24, 2014 as doi : 10.3945/ajcn.114.087775.
- Hampel D, Shahab-Ferdows S, Domek JM, Siddiqua T, Raqib R, Allen LH. Competitive chemiluminescent enzyme immunoassay for vitamin B12 analysis in human milk. *Food Chem* 2014;153:60-5.
- Jaiswal N, Melse-Boonstra A, Sharma SK, Srinivasan K, Zimmermann MB. The iodized salt programme in Bangalore, India provides adequate iodine intakes in pregnant women and more-than-adequate iodine intakes in their children. *Public Health Nutr* 2014;1-11 [Epub ahead of print].
- Jaiswal N, Melse-Boonstra A, Thomas T, Basavaraj C, Sharma SK, Srinivasan K, Zimmermann MB. High prevalence of maternal hypothyroidism despite adequate iodine status in Indian pregnant women in the first trimester. *Thyroid* 2014;24:1419-29.
- Jiang H, Li M, Wen LM, Hu Q, Yang D, He G, Baur LA, Dibley MJ, Qian X. Effect of short message service on infant feeding practice: findings from a community-based study in Shanghai, China. *JAMA Pediatr* 2014;168:471-8.
- Khomsan A, Merita, Anwar F, Sukandar D, Riyadi H, Herawati T, Fatchiya A, Dewi M, Madaniyah S, Syarif H. Impact of nutritional education on service quality in the integrated service posts (Posyandu). *Pakistan J Nutr* 2014;13:122-8.
- Kuliwa KB, Verstraeten R, Bouckaert KP, Mamiro PS, Kolsteren PW, Lachat C. Effectiveness of a nutrition education package in improving feeding practices, dietary adequacy and growth of infants and young children in rural Tanzania: rationale, design and methods of a cluster randomised trial. *BMC Public Health* 2014;14:1-16 doi: 10.1186/1471-2458-14-1077.
- Macharia-Mutie CW, Omusundi AM, Mwai JM, Mwangi AM, Brouwer ID. Simulation of the effect of maize porridge fortified with grain amaranth or micronutrient powder containing NaFeEDTA on iron intake and status in Kenyan children. *Public Health Nutr* 2013;16:1605-13.
- Mananga MJ, Kana-Sop MM, Nolla NP, Tetanye-Ekoe, Gouado I. Feeding practices and nutrition insecurity of infants and their mothers in Bangang rural community Cameroon. *J Nutr Food Sci* 2014;4:264. doi: 10.4172/2155-9600.1000264.
- Ndiku MH, Jara E, Sabaté J. Formative research on acceptability of pearl millet in rural eastern Kenya - a pilot study. *Sustainable Agriculture Research* 2014;3:1-8 doi: 10.5539/sar.v3n4p1.
- Nolla NP, Kana Sop MM, Mananga MJ, Ekoue T, Gouado I. Assessment of nutritional status of preschool children in the Bangang rural community, Cameroon. *Int J Biotechnol Food Sci* 2014;2:44-52.
- Sunarti E. Empowering the care of family members to improve child nutritional status. *Int Federation for Home Economics* 2014;section 3:88-96.
- Ukegbu PO, Anyika-Elekeh J, Uwaegebute AC, Ignatious J, Echendu CA, Nkwoala CC, Nzeagwu OC, Asumugha VU, Henry-Unaeze HN. Breastfeeding knowledge, beliefs and practices of mothers in Umuahia north local government: a baseline study. *Nigerian J Nutr Sciences* 2013;34:107-12.
- Vossenaar M, Doak CM, Solomons NW. Challenges in the elaboration of a field interview instrument to capture information for the evaluation of adherence to the WHO/PAHO Guiding Principles for Complementary Feeding of the Breastfed Child (Participation NF in the printing costs). *Food and Nutrition Bulletin* 2014;35:338-50.
- Wijaya-Erhardt M, Muslimatum S, Erhardt JG. Effect of an educational intervention related to health and nutrition on pregnant women in the villages of central Java province, Indonesia. *Health Education J* 2014;73:370-81.

The publications are available free of charge upon request.





The Nestlé Foundation for the Study of Problems of Nutrition in the World was established in 1966 by a donation from the Nestlé Company on the occasion of its centenary. The Foundation is independent and self-constituting and is managed by a Council consisting of five internationally well-known scientists as Council Members. The Foundation is and has been financially and operationally independent of the Nestlé Company since its inception. The offices of the Nestlé Foundation are in Lausanne, Switzerland.



THE FOUNDATION

GUIDELINES FOR GRANT APPLICATIONS TO THE NESTLÉ FOUNDATION

PURPOSE

The Nestlé Foundation initiates and supports research in human nutrition with public-health relevance in low-income and lower-middle-income countries according to the World Bank classification (see <http://www.worldbank.org>). The results of the research projects should ideally provide a basis for implementation and action which will lead to sustainable effects in the studied populations as generally applicable to the population at large. They should also enable institution strengthening and

capacity building in a sustainable manner in the host country, and further cooperation and collaboration between institutions in developed and developing countries.

The Foundation expects research proposals to be primarily the initiative of local researchers from the developing countries. However, the Foundation will be inclined to consider favourably those applications made jointly by scientists from developed countries

with those from developing countries provided it is clear that the initiative will result in capacity building and human-resource development in the latter and that the bulk of the budget is spent in the developing country.

CURRENT POLICY

Sustainable improvement in human nutrition is one of the major issues in the portfolio of the Foundation. During more than 40 years, basic and applied research in nutrition has been supported by the Foundation in over 50 developing countries. In view of the past activities of the Foundation as well as the world's situation at the turn of the millennium, it was recognized that the public-health relevance of the supported research as well as aspects of sustainability, capacity building and educational issues should have a higher priority. Thus, priority is given to projects which lead to sustainable developments with strong elements of capacity building, and the implementation of the results of a research project should be immediate and sustainable. Highly sophisticated nutrition research of mainly academic interest without public-health relevance has lower priority for support, as do solely laboratory-based studies or animal experimentation.

RESEARCH TOPICS

At present the Foundation's work is primarily concerned with human nutrition research issues dealing with:

- (1) maternal and child nutrition, including breastfeeding and complementary feeding,
- (2) macro- and micronutrient deficiencies and imbalances,
- (3) interactions between infection and nutrition, and
- (4) nutrition education and health promotion.

The precise priorities and goals of the Foundation are modified from time to time to meet emerging public-health and nutritional needs in the developing world.

Studies in other areas of human nutrition research might also be considered, as long as they are dealing with problems of malnutrition in eligible countries (see above). Other areas of research may possibly be considered for support if the applicant can offer specific and convincing evidence and justification for the choice of the research topic.

Funded projects are usually of one- to three-year duration. Projects with a high potential for effective and sustainable improvement of the nutritional status as well as a high capacity-building component will be funded preferentially. The budget of the projects must be appropriate and reasonable and has to be justified in detail.

One of the Foundation's main aims is the transfer of scientific and technological knowledge to target countries. In cases where Foundation-sponsored research projects are realized in collaboration with scientists at universities and research institutes in high-income countries, at least 75% of the budget has to be earmarked for use within the low-income country.

The Foundation does not normally fund:

- (1) projects with low public-health relevance
- (2) projects with doubtful sustainability
- (3) projects lacking transfer of scientific, technical and educational knowledge, i.e. lacking a capacity-building component
- (4) large-budget projects, meaning projects that exceed USD 100,000 per year or USD 300,000 over the total duration of a 3-year project
- (5) nutrition surveys or surveillance studies
- (6) research on food policy, food production and food technology except when linked to an intervention with high potential for sustainable improvement of the nutritional status
- (7) in vitro and/or animal experiments.

ELIGIBLE INSTITUTIONS

Eligible institutions are departments or institutes from universities, hospitals, and other institutions of higher education in low- or lower-middle-income countries. Joint applications from more than one institution (especially South-South) are welcomed. Joint applications from more than one institution involving a North-South collaboration may also be considered. For project applications demonstrating North-South collaboration, it is important that the following criteria are fulfilled: (i) the Principal Investigator is from the South and the proposal has relevance to nutritional problems of the South; (ii) the majority of the budget is earmarked for the South; and (iii) demonstration upon completion of the project of institution- and capacity building in a sustainable manner in the South.

The capacity-building component represents a core issue for all applications to the Foundation. This means that every application needs to demonstrate a training and human-resource and capacity-building component for the developing world. Ideally graduate students or young investigators should play a key role and, where possible, be designated as the Principal Investigator (PI), i.e. be the primary grant applicant, or Co-PI. Established researchers can nevertheless apply but need to clearly indicate the capacity-building component and the designated beneficiaries. All applications need to clearly state the capacity- and human-resource-building components in the host country as well as the long-term sustainability of research in the host institution. Applications from individuals who are non-affiliated researchers and not attached to research or academic institutions can be considered only in very special cases.

TYPES OF AWARDS

The Nestlé Foundation offers different award and grant categories, some of them using a modular



approach; for example, the Pilot Grant Program represents the starting grant module for a later Full Grant Research application. The eligibility criteria as well as the research objectives and topics have to be fulfilled no matter what the award category (for further details see www.nestlefoundation.org):

A. Research Grants

B. Institutional Support

Institutional support involves the support of research or educational projects in specific institutions in low- or lower-middle-income countries which contribute

Grant type	Description	Budget (in USD)
Training Grant (TG)	The Training Grant (TG) Program supports a small research project such as a MSc or PhD thesis project or another training endeavour.	up to 20,000 in total
Pilot Grant (PG)	The Pilot Grant (PG) Program of the Foundation provides support for pilot research that has a high potential to lead to a subsequent full research project grant. Usually the Foundation does not support nutritional survey research, but often to be able to identify areas of problems for potential intervention one has to collect baseline data. If a pilot study (pre-study or baseline study) will create the needed data for a larger research project, the PG program may assist this. The pilot study and PG usually represent the starting point for a later full research grant application (i.e., a SG or LG) to the Foundation.	up to 20,000 in total
Small Research Grant (SG)	The Small Research Grant (SG) provides support for a small research study. This may represent a continuation of a TG or a PG.	up to 50,000 in total
Large Research Grant (LG)	Full grant application of a complete research proposal according to the guidelines.	up to 100,000 per year to a maximum of 300,000 for 3 years
Re-Entry Grants	To encourage post-graduate students to return to their own countries and to aid them in establishing their careers, the Foundation will support a research programme for eligible candidates. The host institution will need to guarantee a post for the returnee and ensure career development within the host institution. Contribution of support to the eligible candidate from the host institution is essential, while support and collaboration from the overseas institution where the candidate trained is helpful.	up to 50,000 in total

to a focused development of capacity and know-how and human-resource development in the corresponding institution.

HOW TO APPLY

Interested scientists should first submit a letter of intent in which they describe very briefly the kind of project they would like to undertake, including an estimated budget. Instructions for the letter of intent are available on the Foundation website at www.nestlefoundation.org. For a submission of a letter of intent only the downloadable form on our website should be used. If the suggested project is compatible with the Foundation's current funding policy, applicants will receive an invitation to submit a full grant proposal. The guidelines for the submission of a full grant proposal are also available on our website. Other formats will not be accepted, neither for the letter of intent nor for the full grant applications.

In the letter of intent and in the grant application, detailed, evidence-based information about the public-health relevance of the project as well as its immediate impact and sustainability have to be reported. This part of the application is as important as the scientific section of the application.

Research grant applications are evaluated twice a year by the Foundation's Council, a group of independent international scientists. The funding of projects is primarily based on the scientific quality, public-health relevance in the short and long term, sustainability, capacity-building component and, last but not least, budget considerations.

Applications are accepted throughout the year, and the Foundation encourages applicants to submit their proposals early to allow sufficient time for internal as well as external reviews. All submissions should be made electronically by e-mail. Final deadlines for submission are January 10 and May 10 for the Spring and Fall Council Meetings, respectively.

For more information consult www.nestlefoundation.org

The Council of the Foundation consists of five Council Members and Advisors. All Council Members and Advisors are internationally well-known scientists with a specific expertise in different fields of nutrition. The Council is self-constituting and operates independently. The Foundation is directed jointly by the Director and the President of the Foundation.

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