4th International Congress Hidden Hunger

Hidden hunger and the transformation of food systems: How to combat the double burden of malnutrition?

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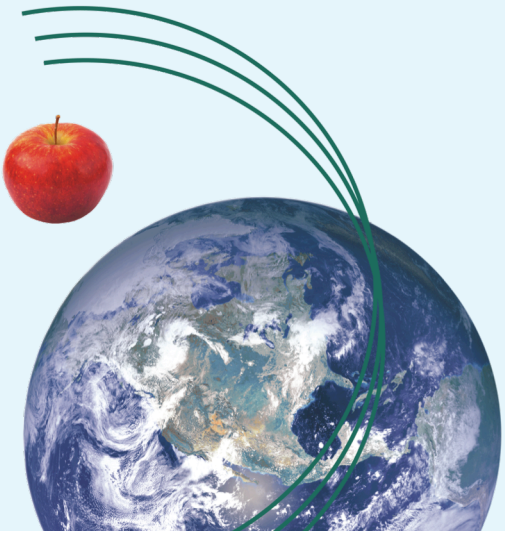

Abstracts – Poster Presentations

(IN ALPHABETICAL ORDER OF PRESENTERS AND WHITHOUT ACADEMIC TITLES)

Anemia prevalence of mothers and children under five among Syrian refugees and Lebanese host communities in Greater Beirut, Lebanon

Abou-Rizk J.[1,2], Jeremias T.[1], Nasreddine L.[3], Jomaa L.[3], Hwalla N.[3], Frank J.[1,2], Scherbaum V.[1,2]
[1]University of Hohenheim / Institute for Biological Chemistry and Nutrition (140), Stuttgart, Germany, [2]University of Hohenheim / Food Security Center (791), Stuttgart, Germany, [3]American University of Beirut, Department of Nutrition and Food Sciences, Beirut, Lebanon

Objective: Host of the world´s highest per capita concentration of refugees, Lebanon is becoming increasingly vulnerable facing the protracted crisis, in return exposing the nutritional status of vulnerable populations, especially children under-five and women of reproductive age. Up-to-date, there is a lack of recent studies assessing hidden hunger, such as anemia and its determinants.
Methods: This project is composed of a cross-sectional study and an intervention study among mother-child pairs of Syrian refugees and Lebanese host communities attending primary health care centers in various vulnerable areas of Greater Beirut, Lebanon. The cross-sectional study was conducted during July-September 2018 interviewing 538 mothers in total using a semi-structured questionnaire. Data on hemoglobin levels (using the HemoCue Hb301+ analyzer), socio-economic characteristics and nutritional status were gathered from 478 mother-child pairs. Data analysis used descriptive statistics, t-test, and chi-square test. Further analysis of dietary intake and nutritional status data are underway.
Results: Overall, 91.2% of the mothers were Syrian and 8.8% Lebanese, with average ages of 27.9±6.0 years for women and 17.4±14.7 months for children. Anemia was found among 22.4% of women (Hb < 12 g/dL) and 35.8% of children (Hb < 11g/dL). Anemia rates of children were found to be significantly higher among those aged 6-23 months as compared to the 0-6 months and 24-59 months age groups (61.5%, 26.1%, 12.4% respectively; p< 0.00) and among mothers aged below 25 years as compared to the 25-29 years and ≥ 30 years age groups (43.4%, 29.6%, 27.0% respectively; p=0.02). Maternal anemia was significantly higher among mothers of children aged 0 to 2 years than mothers of children aged 2 to 5 years (66.3% vs 33.7%; p< 0.05).
Conclusion: Anemia rates were found to be at moderate public health significance level among mothers and children under five in Greater Beirut. Further analysis will be conducted to examine the determinants of anemia, level of food security and nutritional status in order to design an effective nutrition education intervention.

*First and second author have contributed equally and are considered joint co-first authors

Edible insects but not Solanum torvum improved body composition and iron status in protein and iron deficient rats

Agbemafle I.[1,2], Hanson N.[1], Bries A.[1], Stewart J.[1], Reddy M.B.[1]
[1]Iowa State University, Food Science and Human Nutrition, Ames, United States, [2]University of Health and Allied Sciences, School of Public Health, Ho, Ghana

Objectives: Nutritious underutilized foods such as *Solanum torvum* (STO) and edible insects are potential sustainable dietary approaches to prevent malnutrition and improve food security. However, animal studies on protein status and Fe bioavailability of commonly consumed insects and other underutilized foods are spare. This study determined the effect of STO and insect powders on improving nutritional status of malnourished weanling male Sprague-Dawley rats.
Methods: Malnutrition was induced by feeding rats 5% protein with no Fe (LPI) diet for 21 days. During 14-day repletion, 5 groups of rats (n=8) were fed the LPI diet supplemented with cricket, palm weevil larvae, STO, cricket + STO and casein + ferrous sulfate (HPI, positive control) while another group remained on the LPI diet (negative control). Repletion diets contained 15% protein and 20 ppm Fe, but palm larvae diet contained 10 ppm Fe. Body composition was measured by dual X-ray absorptiometry. Hemoglobin (Hb) repletion method was used to compare relative bioavailability (RBV) of the HPI group to the other groups.
Results: Collectively, there were no differences in improved growth rate and body composition measures in groups repleted with edible insects and the HPI group ($p= 0.08$). However, significantly lower growth rate and body composition measures were observed in STO similar to the LPI group. Increase in Hb Fe with cricket and palm larvae was comparable to the HPI group ($p= 0.27$). However, no beneficial increase in Hb Fe was found in the STO group. When RBV was calculated based on Hb Fe and food intake, there were no significant differences in RBV among palm larvae, cricket, or HPI groups ($p= 0.83$). Significantly lower RBV was observed in STO similar to the LPI group.
Conclusions: There were no nutritional benefits with STO, but cricket and palm larvae could be excellent alternative sources of protein and bioavailable Fe and can be sustainable, cheap and locally available foods to prevent malnutrition among humans in countries where they are culturally accepted.

Maternal dietary intakes and anaemia in the first, second and third trimesters of pregnancy and at pre-delivery

Agbozo F.[1,2], Abubakari A.[3], Der J.[2], Jahn A.[1]
[1]*University Hospital Heidelberg, Heidelberg Institute of Global Health, Heidelberg, Germany,* [2]*University of Health and Allied Sciences, School of Public Health, Ho, Ghana,* [3]*University for Development Studies, Nutritional Science Department, Tamale, Ghana*

Objectives: As anaemia remains a major public health problem, we examined the effect of dietary intakes, anthropometry and antenatal care (ANC) practices on the magnitude of anaemia in pregnancy in Ghana.
Methods: Dietary history was taken from 807 cross-sectional women in first trimester of pregnancy using a ten-food-group frequency questionnaire validated against the 24-hour recall. Per the FAO Minimum Dietary Diversity indicator, daily intake ≥5 food groups was proxy for micronutrient adequacy. Anthropometry and red blood cell indices were measured for 415 randomly-selected cohort in first, second, third trimesters and at pre-delivery. Anaemia was classified according to WHO guidelines and adjusted odds (AOR) predicting its severity estimated through ordinal logistic regression at 95% confident level (CI).
Results: Overall, half of the pregnant women (54.4%) were anaemic (mild=31.1%; moderate=23.1%; severe=0.2%) with 10%-point variation across the first (57.3%), second (56.4%) and third (53.3%) trimesters and at pre-delivery (47.7%); 27.8% were anaemic throughout pregnancy while 17.1% were never anaemic. Morphologically, microcytic (79.4%) hypochromic (29.3%) and hyperchromic (23.0%) were most prevalent indicating nutritional deficiencies. Intakes of 41.4% (95% CI:36.6-45.8) were micronutrient inadequate. Teenage (AOR:0.90 95% CI:0.84-0.96), housewife (AOR:0.31 95% CI: 0.12-0.80), women with poor dietary diversity (AOR:2.73 95% CI: 1.35-5.50), fewer ANC contacts (AOR:0.85 95% CI:0.75-0.96) and lower mid-upper arm circumference (AOR:0.87 95% CI:0.82-0.94) increased risk for moderate/severe anaemia but not mild anaemia. Obese women had lower risk (AOR:0.37 95% CI: 0.18-0.74). Other determinants that increased risk including undernutrition, no dietary counselling, malaria, iron-folic acid non-use, sickle cell and preeclampsia were observed in specific time-points.
Conclusions: Findings affirms the role of dietary intake in anaemia aetiology, but the manifold risk factors necessitate a wide range of holistic and integrated solutions. Decline of anaemia during pregnancy suggests positive impact of ANC and supports strengthening ANC services and investing in dietary diversification approaches. Owing to obesity lowering anaemia risk, it is crucial not to fuel the obesity epidemic by promoting healthy diversified intakes while limiting excess energy intake during pregnancy.

The outcome of price policy in the food production and agricultural systems in Syria

Almohamed S.[1], Birner R.[1]
[1]*University of Hohenheim, Institute of Agricultural Sciences in the Tropics (Hans-Ruthenberg-Institute, 490c), Stuttgart, Germany*

Through its subsidy agricultural policy, Syria has been able to achieve food self-sufficiency in an agricultural area that does not exceed 31% of the total area, out of which 80% represents rain-fed agriculture.
The objective of this research is to evaluate the economic and social impacts of the liberalisation of the diesel price on agricultural production using the national official data of the Ministry of Agriculture and Agrarian Reform, the Central Bureau of Statistics, the FAO and World Bank database and relevant scientific publications.
The results show that the Syrian agricultural policies have not been taken into account the rational management of the scarce water resource, however, the region of Middle East suffers from two drought waves in each decade. In order to rationalize and reduce water use in the agriculture the government removed the subsidy of diesel in 2008 and raised its price to 257% which reflected in increasing the costs of irrigation, transport and input prices more than 100%, and the value of gross margins became negative, particularly in irrigated agriculture in the northeast region which is called the national food basket. The farmers in this region cultivate wheat and cotton in large scale areas and the agriculture represents the main source of income. A huge immigration wave occurred in this year (300 thousand people) from Northeast to Southern region searching for new livelihoods. Moreover, the wheat production declined by 50%, and Syria had in this year to import a half of its wheat need after 25 years of food self-sufficiency and the fallow land rose from 16 to 27% between 2007-2009, and many irrigated farms turned to rain-fed crops like barley.
Keywords: Agricultural policy, self-sufficiency, diesel subsidy, Syria.

Anemia prevalence in mother-infant pairs in Bukavu, DR Congo

Beitze D.E.[1], Kavira Malengera C.[1], Frank J.[1,2], Amani Kabesha T.[3], Scherbaum V.[1]
[1]University of Hohenheim, Institute of Biological Chemistry and Nutrition, Stuttgart, Germany, [2]University of Hohenheim, Food Security Center, Stuttgart, Germany, [3]Université Evangélique en Afrique, Department of Public Health, Research Department, Bukavu, Congo, the Democratic Republic of the

Objectives: In the Democratic Republic of the Congo, malnutrition among mothers and children is highly prevalent. In a person's life, nutrition during the first 1000 days, beginning at conception, plays an important role for development and health. Therefore, the nutritional status of lactating mothers and their infants aged 2-8 months in Bukavu, DR Congo was assessed as baseline of a nutritional intervention study.
Methods: In three semi-rural hospitals of Bukavu mother-infant pairs have been recruited after delivery for a follow-up study. This includes a three-monthly randomized, controlled intervention which takes place in the assigned health centers. To evaluate the impact of the interventions, anthropometric measurements as well as hemoglobin (Hb) concentrations of mothers and infants and dietary intake of mothers are assessed. For analysis of anemia prevalence, Hb concentrations are adjusted for altitude according to the WHO. Blood and breast milk samples of the mothers are taken before and after the intervention period. 206 mother-infant-pairs have been assessed at baseline of the intervention study, yet. Further, focus group discussions are conducted in order to deepen the gained knowledge.
Results: Anemia was prevalent in 19.9% of mothers (Hb < 12.0 g/dl) and 75.2% of children (Hb < 11.0 g/dl). Of the children, 28.2% suffered from mild (Hb 10.0-10.9 g/dl), 44.7% from moderate (Hb 7.0-9.9 g/dl), and 2.4% from severe anemia (Hb < 7.0 g/dl). There was no correlation (Spearman) of maternal mid-upper-arm circumference (MUAC, in cm) and Hb. Maternal and infantile Hb were very weakly correlated (r_S = 0.179, p = 0.01).
Conclusions: Particularly young children suffered from anemia, indicating a severe public health problem in this study population. The lack of a correlation of Hb with MUAC in mothers demonstrates the presence of hidden hunger. Due to the high prevalence of anemia in young children, interventions should focus on infant feeding practices during the first months of life, but also include maternal nutrition.

The potential role of Neglected and Underutilized Plant Species (NUS) in improving women's empowerment and nutrition in Sub-Saharan area

Conti M.[1]
[1]*University of Pavia, Department of Public Health, Experimental and Forensic Medicine, Unit of Human Nutrition, Laboratory of Dietetics and Clinical Nutrition, Milano, Italy*

In the context of nutrition transition, Sub Saharan Africa women are clearly the most critical target group from a nutrition standpoint, and if we look at women´s role in food production, huge discrimination still exists. Food-based women-centered strategies are recommended to address nutrient gaps, but also to educate and empower women. In this context, local natural resources, such as African Neglected and Underutilized Plant Species (NUS), may contribute adding nutritional value, enriching diet diversity and ensuring nutrition security. The aim of the current review is to focus on the nutritional status of the Sub-Saharan African population and the role of local agriculture strategy to improve food production, diet diversity and also to increase income-generating activities for the woman. Moreover, the nutritional properties of the most important NUS are discussed.

Time to act - Institutional and programmatic innovations in Cameroon, Ethiopia, Rwanda and Senegal to tackle malnutrition in all its forms

Demmler K.M.[1], Glatzel K.[2], Tankari M.[2]
[1]*Imperial College London, Centre for Environmental Policy, London, United Kingdom,* [2]*International Food Policy Research Institute, Dakar, Senegal*

Objectives: Despite recent efforts and progress in tackling undernourishment, stunting and micronutrient deficiencies, increasing levels of overweight and obesity are becoming a rising challenge in many countries in Africa. All forms of malnutrition and related non-communicable diseases (NCDs), like diabetes and coronary heart diseases place an immense burden on these economies. Identifying the progress of some African countries fighting all types of malnutrition and their institutional, policy and programmatic innovations will be essential for others to take concerted and preventative action.
Methods: The selection of countries draws on their relative decrease of the Global Hunger Index between 2000 and 2018. Based on this and efforts to operationalize actions and guidelines on overweight/obesity, NCDs and physical activity, the four top ranked African countries, Cameroon, Ethiopia, Rwanda and Senegal, were selected. Given the countries' institutional and policy innovations, recommendations are derived to allow other countries to replicate what works to prevent and reduce malnutrition at the individual and household levels.
Results: Several common features distinguish the four African countries that have made significant progress towards reducing malnutrition. All have been able to carry out successful interventions at the political, institutional, and programmatic level to adopt comprehensive policies on nutrition, prioritizing interventions tackling the increasing levels of overweight/obesity and NCDs. All countries have created broad partnerships and set up mechanisms to coordinate a coherent agenda on nutrition across government; strengthen food-system regulation and controls to raise the supply of safe and nutritious food; strengthen national agricultural and nutrition research to expand biofortication; expand access to nutrition education; support collective action and initiatives that enhance the leadership role of women in the area of nutrition; and invest in the availability and use of better data for more effective interventions.
Conclusions: As the experience from these four countries has shown, African governments can successfully reduce malnutrition. Further, policies and interventions will be needed that go beyond solely fighting undernourishment to making improvements in the provision and quality of diets as a whole, including clear targets on overweight/obesity, NCDs and physical activity in order to fight malnutrition in all its forms.

Reducing the burden of iron deficiency anemia in cote d'ivoire through fortification

Detzel P.[1]
[1]*Nestle Research, Lausanne, Switzerland*

Background: Iron deficiency anemia (IDA) is highly prevalent in the Cote d'Ivoire and has severe health and economic consequences. In this paper, we apply a health economic model to quantify the burden of IDA, and the contribution of nation-wide mandatory iron fortification of wheat flour and voluntary iron fortification of condiments to the reduction of this burden.
Methods: The analysis for the population from six months to 64 years builds on published reviews and publicly available datasets and is stratified by age-groups and socio-economic strata using comparative risk assessment model.
Results: Without the impact of these fortification strategies, the annual burden of IDA is estimated at 242,100 disability adjusted life years (DALYs) and 978.1 million USD. Wheat flour and condiment fortification contributed to a reduction of the IDA burden by approximately 5% each.
Conclusions: The findings of this study provide additional input for policy makers about the magnitude of the impact and can support the conception of future fortification strategies.

The double burden of malnutrition during the conflict in Yemen

Dureab F.[1], Ismail O.[2], Alfalahi E.[2], Jahn A.[1]
[1]Heidelberg University Hospital, Institute of Global Health, Heidelberg, Germany, [2]World Health Organization, Sana'a, Yemen

Population of Yemen are facing the worse life crises in the current history, About 3.3 million are acutely malnourished, with 462,000 children suffering from Severe Acute Malnutrition. Yemen is considered having 47% of stunting in children U5 making the country having one of the highest rates of chronic malnutrition, while wasting represents 15% in children under five years old. Combination of malnutrition and infection causes most of preventable death during crisis, thus this study aims To determine the prevalence of acute malnutrition and associated infections among children under five years old during the conflict.

Methods: This is a population-based survey was conducted in 18 districts distributed in two governorates in Yemen (IBB and Sana'a). The data collection took place in 234 clusters (villages). This study targeted 5,293 children less than 5 years old (0-59 months of age) in 4240 households.

Results: Morbidity is most common among children particularly malnourished children, 31% of the children were complained of fever within the last week preceding the survey in both governorates. The prevalence of suspected measles was 1.5% in both governorates. The suspected measles cases were three time higher among SAM than other children (4.5% with P Value less than 0.05). The risk of illness increased significantly with the severity of malnutrition among targeted children. The univariate logistic regression analysis reveals a statistical high significant association between the history of measles in the last week preceding the survey and Severe Acute Malnutrition (SAM) than other nutritional status of the children in the same study (OR = 3.60; 95% C.I. 1.85-7.02 and p value =0.00), similarly for other health problems Diarrhea, Fever and cough.

Malnutrition is considered one of the most critical issues that are facing Yemen, which increase the burden of communicable diseases among the vulnerable groups. Furthermore The current crisis, whether directly or indirectly, has resulted in a dramatic increase in the number of malnourished children. Scaling up the nutritional interventions in the targeted areas through integrated interventions include lifesaving nutrition and health services and IYCF is highly recommended. Donors and the humanitarian Aid community in the country should push to increase the availability and the accessibility of food to reduce the prevalence of malnutrition in Yemen.

Eating the soil: how soil properties affect food's mineral composition

Fischer S.[1], Hilger T.[1], Jordan I.[2], Karungi J.[3], Cadisch G.[1]
[1]University of Hohenheim, Institute of Agricultural Sciences in the Tropics, Stuttgart, Germany, [2]Justus-Liebig-Universität Gießen, Zentrum für Entwicklungs-und Umweltforschung, Gießen, Germany, [3]Makerere University, Department of Agricultural Production, Kampala, Uganda

Objectives: Hidden hunger remains a big concern for Sub-Saharan Africa. Soil quality is responsible for the quantity and quality of produced food. While mineral composition with soil fertility are often used to judge fodder quality or plant health, the importance of soil properties on food quality, and human nutrition remain relatively unknown. This study looks at plant-soil interactions by comparing maize grain mineral nutrient concentrations in Kapchorwa, Uganda (high fertility) and Busia, Kenya (low fertility). The main research questions were: i. Do these two regions differ in mineral concentration in food? ii. Which soil properties affect food nutrient composition?
Methods: Composite maize samples paired with soils (n=61) were collected in Busia and Kapchorwa from randomly selected farmer fields. All samples were measured for total concentration of plant macro (Mg, P, S, K, Ca) and micronutrients (Mn, Fe, Cu, Zn). Texture, pH, eCEC, and N and C content were analysed in soils. Data per field on yields, species diversity, fertilisation and distance to household were collected. Canonical Correspondence Analysis (CCA) was used to identify the trends.
Results: Busia had much sandier soils, with significantly lower N and C contents, and significantly lower amounts of trace elements, than Kapchorwa. The yield gap of Busia (68%) was significantly higher than that of Kapchorwa (6%). Kapchorwa had a significantly higher concentration of all minerals in grain (mean difference macro: 46%; micro: 70.5%). The CCA showed most grain nutrients in Busia affected strongly and positively by soil C. The soil properties showing the most effect on grain nutrient content in Kapchorwa included texture, biodiversity, and N and C content, both positively and negatively affecting most grain nutrients. In Busia, the grain nutrients largely clustered around soil C, whereas in Kapchorwa the grain nutrients were affected by a greater variety of soil properties.
Conclusions: Differences in soil fertility have a very strong effect on nutrient concentration within maize grain. The actual amount of soil elements does not seem to be the most deciding factor in the resulting food nutrient content. Other factors influencing bioavailability and soil organic matter appear to be more deciding, particularly in poor soils. Solving soil fertility bottlenecks to improve nutrient concentration in low soil fertility areas, could be a big step towards lowering the susceptibility to hidden hunger.

Anthropometric measurements determinant nutritional status of urban primary school children in selected areas of Iran and India: A comparative study

Hooshmand S.[1]
[1]*Imtenan International health and Trade, Food and Nutrition, Den Haag, Netherlands*

Objectives: Malnutrition is a widespread problem in developing countries. Information on nutritional status of primary school children are not enough in Iran and India. The present study, made to assess prevalence of undernutrtion, stunting and wasting among urban school children in Mumbai in India and Ahwaz in Iran.
Methods: Height and weight of 4570 including 2234 Iranian (1016 boys, 1218girls) and 2336 Indian (1240 boys, 1096 girls), aged 6-9 years, attending primary schools residing in Mumbai, India and Ahwaz, Iran were measured and the body mass index (BMI) calculated. The World Health Organization's (WHO) anthropometric indices of weight-for-age (WA) and height-for-age (HA) and weight-for-height were used to assess the children´s nutritional status.
Results: Underweight, stunting and wasting occurred in 3.2%, 1.5% and 4.1%% of Indian and 0.2%, 5.4% and 1.7% of Iranian children. WAZ mean scores of children were -0.071±1.195 for boys and -0.287±3.241 for girls in Iran and -0.238±0.823 for boys and 0.108±1.080 for girls in India. HAZ mean scores were -0.163±1.219 for boys and -0.515±3.141 for girls in Iran and -0.028±0.770 and -0.017±0.993 for girls in India. BMI mean scores were 0.044±1.081 for boys and 0.304±0.957 for girls in Iran and -0.345±0.796 for boys and -0.181±1.281 for girls in India. Among Iranian children0.2% (χ^2=30.428, p=0.000) and 3.2% Indian children had weight for age z-scores below - 2 SD (χ^2=55.361, p=0.000). Only 1.5% Indian children and 5.4% Iranian children had height for age z-scores below -2SD (χ^2=11.553, p=0.000 and χ^2=24.034, p=0.000). In Iran 1.7% and 4.1% of Indian children were wasted (χ^2=11.176, p=0.004 and χ^2=40.088, p=0.000).Among Indian children, 1.3% had weight for height z -scores > +2SD compared to 3.6% Iranian children.
Conclusion: Most of children in both countries were well nourished. Stunting was more prevalent in Iran than India. In India children were more wasted than Iran. The percentage of stunted children was more in Iran than in India, and a slightly higher percentage of Iranian children tended to be overweight / obese compared to Indian children.

Vitamin D_2 from sun-treated oyster mushroom as an adjunctive therapy of tuberculosis

Keflie T.[1], Lambert C.[1], Nohr D.[1], Biesalski H.K.[1]
[1]*Institute of Biological Chemistry and Nutrition, Stuttgart, Germany*

Background: Vitamin D deficiency (VDD) plays an important role in tuberculosis (TB) prevalence and in susceptibility to active disease. Most TB patients have VDD. Although its pharmacological use has been replaced by the current anti-TB drugs, the immunomodulatory and anti-microbial effects of vitamin D provokes further research. The aim of the present study was to evaluate the effects of vitamin D_2, provided by sunlight irradiated oyster mushroom, on the treatment outcomes of TB.
Materials and methods: Randomised two-arms trial was conducted in central Ethiopia. Sixty-four TB patients who were taking anti-TB drugs were included in the study. Sun treatment increased the production of vitamin D_2 in oyster mushroom. Intervention group was provided with sun-treated oyster mushroom sandwich (containing 146 µg vitamin D_2) from Monday to Friday for 4 months' duration. Evaluation was made at the beginning and end of follow up. The primary outcome was clinical improvements and the secondary outcome was sputum smear conversion. High performance liquid chromatography was used to measure Vitamin D_2 whereas, enzyme linked immunosorbent assay was used to analyse 25 hydroxy vitamin D, cytokines, cathelicidin and C-Reactive Protein. Mycobacterial load was assessed by acid fast bacilli smear examination and culture on Löwenstein-Jensen medium. Statistical analyses were performed using paired 2-tailed t-test, Wilcoxon signed rank sum test, Kruskal-Wallis test, Chi-square, Pearson's and Spearman correlation and multiple linear regression model. P-value < 0.05 was considered as statistically significant.
Results: Vitamin D_2 intervention induced 27.8% increase in the mean serum 25 (OH) vitamin D level and brought progressive improvement in TB score (6.1 ± 3.2 to 2.6 ± 1.8) and significant change in Karnofsky performance status scale ($p < 0.001$) in the intervention group. The changes in culture conversion were not statistically significant. The relationship between 25(OH) vitamin D and immune stimulating interferon (IFN)-g (b= 0.349, p=0.039) as well as the active peptide of cathelicidin, LL-37 (b=0.366, p=0.0.028) was statistically significant.
Conclusions: Vitamin D_2 increased the levels of 25(OH) vitamin D, IFN-g and LL-37 in the blood and successfully improved the clinical outcomes of TB patients. Therefore, sun-treated oyster mushroom can be used as adjunctive therapy of TB, but further studies are warranted.

Combined effect of health care and food insecurity on physical and mental health in Korean adults: results from the Korea National Health and Nutrition Examination Survey, 2012-2015

Kim H.J.[1], Yang N.[2], Yoo S.[2], Lee Y.[2], Kim K.[2]
[1]*Gangneung-Wonju National University, Food and Nutrition, Gangneung, Korea, Republic of,*
[2]*Dankook University, Food Science and Nutrition, Cheonan, Korea, Republic of*

Objectives: This study aimed to examine the combined effect of health care and food insecurity on physical and mental health in a representative Korean population.
Methods: Study subjects were adults aged ≥ 30 years who participated in the Korea National Health and Nutrition Examination Survey.
Results: Among health care factors, unmet health care needs and mental health counselling were different by food insecurity status, showing higher prevalence in food insecure adults. Food insecure men had higher prevalence of underweight and food insecure women had higher prevalence of obesity as compared to food secure men and women. Food insecurity was associated with high risk of all mental health outcomes. For the combined effects of health care and food insecurity, unmet health care needs affected obesity differently between food secure men and food insecure men (interaction p-value=0.0294) and participation in nutrition education or counselling affected between food secure women and food insecure women (interaction p-value=0.0098). In addition, higher unmet health care needs and mental health counselling in food insecure adults were related to higher risk of mental health outcomes.
Conclusions: In conclusion, food insecure adults with insufficient health care had higher risk of health outcomes than food secure adults with sufficient health care. The policy and program for food insecure adults need to provide integrated and persistent mental and physical health care services with basic social services such as food and housing.

Personalized nutrition - an innovative concept to combat the double burden of malnutrition

Kolossa S.[1], Gedrich K.[1]
[1]*Technische Universität München, Ernährungsphysiologie, Freising, Germany*

Personalized nutrition (PN) is an upcoming approach to tackle the prevalence of overweight and nutrition-related diseases. In PN, individual data are collected and analyzed iteratively to generate dietary advice tailored to the individual needs of a person. ICT-based solutions for data collection and dietary recommendations are useful to expand this approach on a population level.
The concept of PN is mainly discussed in the context of developed countries with excessive food supply involving Nutrigenetics and targeting non-communicable diseases. We transfer PN to a scenario of unequal or short food supply, as found in developing countries. Here, PN could identify local and/or individual nutrient deficiencies and target them by recommending the consumption of specific available or even homegrown food items to overcome undernutrition and avoid untargeted countrywide distributions of imported supplements. The use of the scarce resources to grow demanded agricultural products and the support of regional markets might lead to the implementation of nutrition sensitive agriculture and a healthier diet.
As PN is a holistic approach aiming at a balanced diet, it simultaneously targets deficient as well as excessive food intake. This might decelerate the prevalence of double burden of malnutrition in developing countries in the course of nutrition transition.

How breastfeeding friendly is Germany?
The research project *Becoming Breastfeeding Friendly* provides national recommendations for an effective and efficient breastfeeding promotion

Julia Kunath[1], Stephanie Lücke[1], Britta Nagl[2], Katharina Reiss[1], Cornelia Weikert[2], Maria Flothkötter[1]
[1] Healthy Start – Young Family Network, Federal Centre for Nutrition (BZfE), Bonn, [2] National Breastfeeding Committee, Federal Institute for Risk Assessment (BfR), Berlin

Background
Breast is best: Breastfeeding is a resource that can strengthen the bond between a mother and her child. It is also associated with many short- and long-term health benefits for mother and child and thus contributes significantly to disease prevention.
Breastfeeding rates in Germany have been at a constantly low level for decades. Socio-economic factors decisively influence breastfeeding behaviour.

Goals
The Becoming Breastfeeding Friendly research project intends to improve the framework conditions for breastfeeding in order to increase breastfeeding rates in Germany sustainably. Initiated by the *Federal Ministry of Food and Agriculture*, the project is carried out by the *Healthy Start – Young Family Network* and by the *National Breastfeeding Committee* in cooperation with Yale University and runs for two years, from 2017 to 2019.

Methodology
The research project is based on the Breastfeeding Gear Model developed by the School of Public Health at Yale University. It pursues an overall societal approach and integrates all relevant fields of action around the topic of breastfeeding that need to interlock: Advocacy, Political Will, Legislation, Funding, Training & Program Delivery, Promotion, Research & Evaluation, Goals & Coordination. It includes the evaluation of 54 benchmarks leading to an overall score that expresses breastfeeding friendliness in Germany and allows a direct comparison with other countries participating in the project (so far: Ghana, Mexico, Myanmar, Samoa, UK).

Procedures
In Germany, a commission of experts dealing with expectant and young mothers and infants collects and evaluates relevant information. Public relations work accompanies the process in order to increase awareness of breastfeeding and its health benefits among the general population and experts.

Benefits
1. The **current situation in Germany is illustrated** systematically under the best possible consideration of all actors and areas in connection with the topic of breastfeeding.
2. **Strengths and weaknesses are identified,** including the derivation of **calls to action,** while impulses for breastfeeding promotion are set.
3. **Structured scientific support**, involving interdisciplinary exchange among all relevant actors, is provided while structures are built and forces for breastfeeding promotion are joined.

The research project makes a valuable contribution to promoting maternal and child health, to the strengthening of social equity and to breastfeeding protection in Germany.

Access to bread in rural areas of Burundi: case-study of commune Mukike

Kwizera V.[1]
[1]*Bursa Uludağ University, Plant Protection, Bursa, Turkey*

Food is one of the three basic needs for humans. The poverty in developing nations is mostly evaluated using the access to bread. The Institute of Education and Research for Rural Development (DREI) has carried out a survey in rural areas of Burundi to assess the access to wheat bread and other bakery products. In September 2018, a survey was carried out in MUKIKE, one of the 119 communes of Burundi. A sample of 150 households in a population of 5,720 was selected to be interviewed. The results have mainly shown that, demographically, 86.36% of household farm managers had a primary level education while 13.64% had a secondary level; 62.12% of household farm managers were men; women were 37.88%. There were a wide range of food crops,even though there were a low volume of production. These results also revealed a low consumption of fruits and vegetables which volume of consumption remained far below the standards of the World Health Organization, an insufficient agricultural production (87.88% of respondents) and diet (80.30%), less than 5% had access to electricity, no bread expert, no food processing infrastructures. Despite the production of wheat in this area, there was no bread oven. Only three shops produced dougnuts. Using local materials, during the time of the survey, we built one wood oven to prove the potentials in bread of the areas. Agricultural techniques to increase production, food technology and nutrition education are needed to achieve optimum consumption of staple foods, fruits and vegetables.

The untapped role of baobab in improving nutrition and food security status of households residing along the baobab belt in Kenya

Momanyi D.[1], Owino W.[1], Makokha A.[1], Esther E.[2], Habte T.[2], Krawinkel M.[2]
[1]Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya, [2]Justus-Liebig-University, Giessen, Germany

Objectives: One of the potential ways to mitigate the impact of climate change on agriculture and ensure a food secure continent is by promoting the use of drought tolerant crops. One such crop is the baobab tree which dominates specific geographical areas in Kenya in form of a Y shaped belt. It has in the recent past become of interest in sustainable utilization in economic and nutritional empowerment due its high nutritional value.The belt cuts across Kitui and Kilifi counties, which are marginal agricultural potential areas with a population that is vulnerable to malnutrition and recurring food insecurity episodes whose prevalence are unknown.Baobab has great potential in enhancing household food security and improving nutritional status. This potential, however, remains untapped among households residing along the baobab belt in Kitui and Kilifi counties of Kenya. The study was designed to evaluate the prevalence of food insecurityand malnutrition of households and the untapped role of baobab in food security and nutrition status.
Methods: A cross-sectional study design among 216 caregiver/child was carried out between July and November 2017. Households residing along the baobab belt were randomly selected with baobab being used as an inclusion criterion.
Results: Majority (91.2%) of the households were food-insecure. The prevalence of malnutrition that is stunting (28.6%), wasting (11.6%) and underweight (25%) was high among children. About 14.8% of the caregivers were underweight, 18.1% were overweight and 8.8% were obese. Despite a large proportion of households owning baobab trees, use of the fruit was limited to chewing the fresh pulp. Leaves on the other hand, were used by 43.5% of the household in Kilifi County mainly in softening other vegetables during cooking.Fruits and leaf harvesting patterns coincide with the hunger gap in both counties yet its use as an emergency food was limited. The proportion of income from baobab contributed to only 2.05% of the total income in Kilifi and 0.8% in Kitui County.
Conclusions: Households residing along the baobab belt have been characterized by high food insecurity and malnutrition rates among children and caregivers. Despite Kitui and Kilifi counties hosting a huge baobab population, results highlight it`s huge untapped subsistence and economic role. Creating awareness on baobab`s potential will increase its utilization and consequently improve food insecurity and nutrition status of households.

Safe and nutritious food: ideal family! - Improving food hygiene behaviours through emotional drivers

Müller A.A.[1], Sobhan S.[1], Huda T.M.[2], Wendt A.S.[1], Waid J.L.[3], Gabrysch S.[1]
[1]University of Heidelberg, Heidelberg Institute of Global Health, Heidelberg, Germany, [2]Icddr, B, Dhaka, Bangladesh, [3]Hellen Keller International, Dhaka, Bangladesh

Objectives: Insufficient intake of nutritious food and repeated enteric infections are key causes of undernutrition in children. Although a known contributor to diarrheal disease and highly prevalent in low-income settings, microbial contamination of food has received relatively little attention in nutrition programs. Consistent adoption of handwashing and food hygiene practices can considerably reduce microbial food contamination and thereby diarrheal incidence.
We designed, implemented, and evaluated an integrated food hygiene module within a nutrition-sensitive intervention in rural Bangladesh with the aim to improve food hygiene behaviors.
Methods: The "Food and Agricultural Approaches to Reducing Malnutrition" (FAARM) cluster-randomized trial (2015-2019) is evaluating the impact of a Homestead Food Production program in Sylhet, Bangladesh on child undernutrition. We designed a behavior change intervention to strengthen the food hygiene component in FAARM. The module employed emotional drivers, engaging group activities and individual household visits to improve food hygiene practices among study participants. It focused on the improvement of 6 key optimal feeding and food hygiene behaviors and was implemented from July 2017 to February 2018 in 1341 intervention households. During the food hygiene intervention, household attendance was documented and the women's practice of food hygiene behaviors was assessed in household visits by spot-checks and short observations.
Results: The food hygiene intervention was well accepted, with more than 80% attendance at all events. At the end of the intervention, 496 households (39%) were awarded a prize as an "ideal family", meaning they practiced at least 5 out of 6 behaviors. Households with high attendance were more likely classified as an "ideal family" than households with low attendance. Other associated factors were household wealth and maternal education.
Uptake of food hygiene behaviors varied by behavior. Only 49% of treatment households continuously practiced cleaning of utensils and 48% handwashing before food preparation and feeding, while 70% of Households practiced safe food storage and 89% of households reheated of leftover foods.
Conclusions: The integrated feeding and food hygiene intervention was well attended and accepted by households, however uptake of all behaviors was not equal. Future studies will show if the intervention was able to decrease food contamination and infection.

Professionalization of agricultural extension services in Nigeria: a strategy to combat the double burden of hunger and malnutrition

Olorunfemi O.D.[1,2], Oladele O.I.[1]
[1]*North West University, Department of Agricultural Economics and Extension, Mafikeng, South Africa,*
[2]*University of Ilorin, Department of Agricultural Extension and Rural Development, Ilorin, Nigeria*

The burden of hunger and malnutrition is still a serious threat to the development of many African countries including Nigeria and the challenges facing rural farming households resulting in dwindling production and food insecurity remain a great concern in the agricultural sector. This has made the discussion in the field of agricultural extension not just focused on educating and building the production capacity of farmers for increased output but integrating and promoting nutrition sensitive extension and advisory services. However, the performance of the Nigerian extension services in this regard is said to be unsatisfactory due to stagnant professional development, unaccountability and general poor work ethics. In view of these therefore, there is the need to tackle the problem of ineffective extension and rural advisory services delivered to farmers through the professionalization of extension services which will involve the accreditation, registration and certification of extension service providers by a recognized and legalized professional body as obtainable in other developed countries of the world. Therefore, the purpose of the study was to analyse the perceived effects of professionalization of extension services by extension agents in Nigeria. The study was carried out in South West Nigeria. A structured questionnaire was used to elicit data from three hundred and one (301) public agents and fifty-five (55) private agents that were selected through a stratified random sampling technique. The findings revealed that extension agents in both organizations exhibited a positive perception of the effects of professionalization of extension services in enhancing and improving delivery. Regression analysis revealed that variables such as the extension agents' knowledge, attitude, educational qualification, years of experience and rural-urban background were significant determinants of their perceived effects of professionalization on service delivery. It was recommended that there is the need for extension agencies to support continuous professional development of extension agents through trainings and acquisition of relevant higher degrees that will help to enhance their knowledge thus upgrading their professionalization-readiness status. This will facilitate the smooth implementation of professionalization in the area thus ensuring more effective rendering of nutrition-smart agricultural advisory services to farmers.

Energy and time for nutrition: implications of gendered patterns of labour intensity on nutritional status in agrarian contexts

Picchioni F.[1], Zanello G.[1], Srinivasan C.S.[1], Webb P.[2]
[1]*University of Reading, School of Agriculture, Policy and Development, Reading, United Kingdom,*
[2]*Tufts University, Medford - Massachusetts, United States*

Objectives: Agriculture is the main source of food and income for rural households living in low and middle income countries (LMICs). Still, a large number of rural dwellers suffer from high levels of undernutrition and micro-nutrient deficiency (1). Linkages between agriculture, work allocation and nutrition are key in explaining the agriculture-nutrition disconnection but these pathways are not well understood (2, 3). Our paper addresses this gap by developing an integrated approach to examine how tensions between time allocation and energy costs in performing productive and reproductive activities translate into nutritional outcomes in LMICs.
Methods: We apply an innovative method that integrates energy expenditure with an analysis of gendered labour allocation. By using accelerometer devices, we measure the intensity of physical activities of women and men in rural communities in Ghana and Nepal. The 53,760 hours-worth of data on energy expenditure is triangulated with hourly recordings of time spent in different activities and analysed against anthropometric measures.
Findings: Women and men work jointly in many aspects of productive work that are energy-intensive. However, the domestic domain remains predominantly feminized and time-intense. This means that pressures of agricultural work compete with routine labour needs, particularly creating challenges for women given the non-seasonal nature of the reproductive work.
Conclusions: While time is a precious input to nutritional outcomes, time-poverty is a widespread issue in rural areas, especially among women. On the other hand, the nature of work and its energy cost plays a major role in determining individual energy balance. This study also shows how advances in accelerometry technology offer a valuable opportunity to incorporate the component of physical intensity of work to the time-use pathway and help to understand some of the complex interlinkages that shape malnutrition in rural areas in LMICs.
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Tackling malnutrition by transforming an annual plague into a nutrition opportunity for families in Madagascar

Randrianajaina T.[1], Rambeloson J.Z.[2,3], Rakotondravelo M.[4], Rambelontsalama E.B.N.[4], Rambeloson J.[5]

[1]Concept Mihary Startup, Head Office, Antananarivo, Madagascar, [2]FHI360, Technical Advisor, Washington DC, United States, [3]Concept Mihary Startup, Principal Investigator, Antananarivo, Madagascar, [4]Concept Mihary Startup, Antananarivo, Madagascar, [5]University of Georges Mason, Fairfax, United States

Madagascar is among the 10 highest burden countries for malnutrition. Protein-energy malnutrition, anemia, and vitamin A deficiency are major public health problems. Animal-source foods are not affordable to the major of people, who rely on maize or beans and famine-foods. Hunger is exacerbated by an annual locust invasion that destroys thousands of hectares of cereal crops and contributes to the country's extreme poverty.

Objectives: We studied the feasibility of turning a yearly locust invasion into a protein-rich food supply for families. We assumed the availability of *Locusta migratoria capito* and *Nomadacris septemfasciata* throughout the year if pesticides are withheld. The current policy of large-scale government spraying of pesticides from planes is logistically complex, costly, and is damaging the fragile environment.

Methods: We conducted 20 focus group discussions with females and males aged 18-24, females and males aged 25-59 years, and adult female artisans (basket and net makers) in five swarm areas in Madagascar's south during November-December 2016 to understand enablers and barriers to collection, preparation, and consumption of locusts. We organized a contest to attract vulnerable youth aged 18-24 to be trained in “start-ups” to collect locusts and process and market the products.

Results: Enablers include consumption by all ages (including infants), in Tandroy culture (key ethnic group in the south), perception of locusts as a delicacy, tasty, and free. Daily average current consumption varies between 50 heads (infants) to 500 heads (youths and adults). Locally appropriate technologies for mass collection include digging trenches in fields and entrapment via sisal netting. Common preparations include boiling in salted water, drying, skewing, frying, and locust flour (mainly for infants). The contest was successful in motivating youths to participate in the initial pilot.

Conclusions: We confirmed the feasibility of a first-in-Africa pilot to promote food security/local resilience and tackle multiple endemic challenges through cross-sector collaboration and motivating vulnerable youth. Our pilot is contributing to advocacy in Madagascar to reduce or end the use of pesticides. It also responds to the government's desire to address the protein-energy malnutrition burden in an integrated way with multiple stakeholders.

Keywords: Innovation, Integrated approach, Locust, Plague, Protein-Energy Malnutrition, Madagascar.

Unfavorable change in vitamin A kinetics induced by iron deficiency is partially reversed by iron repletion in rats

Li Y.[1], Wei C.-H.[1], Green M.H.[1], Ross A.C.[1]
[1]*The Pennsylvania State University, Department of Nutritional Sciences, University Park, United States*

Objectives: The current study investigated the impact of iron repletion on vitamin A (retinol) metabolism and kinetics in iron-deficient rats.
Methods: All diets contained a marginal level of vitamin A. Weanling rats were assigned to either a modified AIN-93G diet, with adequate iron (control group, CN), or the same diet with low iron (iron deficient group, ID-). After 5 weeks of dietary treatment, n=4 rats from the CN and ID- diet groups were euthanized for the baseline measurements, and the remaining rats, n=6 for CN and n=10 for ID-, received an i.v. dose of ^{3}H-labeled retinol emulsion as tracer to initiate the kinetic study; all rats continued on their assigned diet during the first 21 d of the ^{3}H-retinol kinetic analysis. On day 21 after dose administration, half of the ID-rats were switched to an iron replete diet, thus creating an iron-repleted group (ID+). Serial samples of tail vein blood were collected from each rat at 34 preselected time points. On day 92 after dosing, all rats were euthanized. Iron and vitamin A status were determined, and model-based compartmental analysis was applied to the plasma tracer response profile to develop vitamin A kinetic models for the three groups, CN, ID-, and ID+.
Results: As expected, rats fed a low iron diet developed iron deficiency; these rats exhibited decreased plasma retinol and relatively higher liver vitamin A storage at baseline, before beginning the ^{3}H-retinol kinetic study. At the study conclusion, rats in the ID+ group had recovered from iron deficiency as assessed by normalization of hematocrit, hemoglobin, and plasma and tissue iron. Whereas elevated liver vitamin A and reduced plasma retinol continued in ID- vs. CN rats, both of these values in ID+ rats were comparable to CN rats. As revealed in the compartmental model, although ID+ rats showed increased liver mobilization of vitamin A, some characteristics of their vitamin A kinetics persisted, remaining similar to ID- rats.
Conclusion: Iron repletion restored plasma retinol concentration and halted liver vitamin A sequestration in iron deficient rats by stimulating liver vitamin A mobilization, but pre-existing iron deficiency may have some long-term and possibly irreversible effects on vitamin A kinetics.

An analysis of the link between mother's education and child malnutrition in rural Malawi

Sanga L.R.[1]
[1]*University of the Western Cape, Institute for Social Development, Zomba, Malawi*

Child malnutrition is a major public health concern in Malawi. Almost 40% of under-five children in Malawi suffer from malnutrition. Children born to poor mothers with low levels of education are at the highest risk of malnutrition. Great disparities are also seen between children born in rural areas and those born in urban areas. This study examines the linkages between mothers' education attainment and child malnutrition. The Capability Approach and the UNICEF Conceptual Framework on child malnutrition were used in ascertaining how education affects mother's choices and practices on child's health and nutrition. Elements of Qualitative and Quantitative research approaches were employed to provide depth and breadth of how mother's education affects a child's health and nutrition. The Explanatory Sequential Mixed Method Design was used. Combining elements of Qualitative and Quantitative research methods to provide depth and breadth of how mother's education affects a child's health and nutrition. Findings from the Quantitative analysis of the 2015-2016 Malawi Demographic and Health Surveys data on child malnutrition and women's education informed the qualitative study. The results guided in purposively sampling participants from Mangochi and Machinga districts in Malawi for the Qualitative research. Stata 14 was used to analyse quantitative data. Themes were drawn from the qualitative data, and an analysis of the recurring themes was done using Atlas. ti 8. The study found that there is an association between a mother's education and child malnutrition. Children born to mothers with secondary and higher education qualification have lower odds of malnutrition and poor health. Malawi needs to invest in girl's education; particularly in rural areas where many girls do not transition to secondary school as one way of combating child malnutrition.

Keywords: Child malnutrition, Malawi, Capability Approach, mother's education

Influence of ultraviolet irradiation on the Vitamin D content in button mushrooms accountingundesired byproduct formation

Sommer K.[1], Glanz L.[1], Vetter W.[1]
[1]*University of Hohenheim, Stuttgart, Germany*

Vitamin D isknown to be one of the micronutrients which shows a poor supply in human nutrition. This applies not only to undernourishment because a brought deficiency is also observed in well-developed regions which mainly combat against overnutrition and obesity [1]. In fact,malnutritionand an insufficient exposition to sunlight are the main reasons [2].
Vitamin D is transformed from its precursor sterolby ultraviolet radiation either in the food product or in the skin. Vitamin D itself functions,after further metabolism,as a hormone-like substance.
Hence,vitamin D deficiency resultsin many chronic diseases like impaired immune responses, bone growth and density, cell metabolismandapoptosisas well as disturbed nerve andmuscle activities [3].
In order to counteract these adverse effects new products are entering the market. Recently, UV irradiated button mushrooms with an increased vitamin D content were approved as novel food, andthe corresponding products were already marketed in Germany [4].
In this study we investigated the influence of UVirradiation on dried button mushroompowder. For this purpose we performedUV irradiation experiments of button mushroom powder with different UV-sourcesand exposure periods. Next to remarkably amounts of vitamin D2we also studied and evaluated by-productsof this process (vitamin D2isomers and oxidation products).These measurements by GC/MS also indicated the presence of vitamin D4and its by-products.

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Heritability of drought resistance in Solanum aethiopicum Shum group and combining ability of genotypes for drought tolerance and recovery

Sseremba G.[1,2], Tongoona P.[1], Eleblu J.[1], Danquah E.Y.[1], Kizito E.B.[2]
[1]University of Ghana, West Africa Centre for Crop Improvement, Accra, Ghana, [2]Uganda Christian University, Faculty of Science and Technology, Department of Agricultural and Biological Sciences, Mukono, Uganda

Drought tolerance is a complex trait whose inheritance had not been investigated in *Solanum aethiopicum* L. Shum group. This is partly because of perceived cross incompatibilities in the crop. This study relied on 24 successful crosses from an incomplete 9x4 North Carolina II mating design, evaluated under five watering conditions based on plant growth stage and watering level in order to determine the heritability of drought resistance and combining ability. Subsequent data analyses were based on restricted maximum likelihood. Overall, specific combining ability (SCA) effects were significant across and within watering environments for all study traits. The most highly heritable traits (in the narrow-sense) were identified as leaves per plant, chlorophyll content (CHL), leaf fresh yield and leaf dry yield while leaf area (LA), leaf relative water content (LRWC) and leaf mass area (LMA) were least heritable. However, the broad sense heritability (H^2) was over 0.80 for seven of the traits, indicating that dominance gene action surpass additive gene effects for drought resistance in *S. aethiopicum* Shum. Further analysis showed that LA is suited for selection of best combiners under well-watered and drought-stress (DS) treatments. The LRWC served best in separating the SCA effects of crosses under DS. The CHL produced clear separations of SCA effects under both DS and drought recovery while LMA served best under the latter.

Maternal nutrition status and infant feeding practices among Adivasi children, Birbhum District, West Bengal, India

Stiller C.K.[1,2], Golembiewski S.[2,3], Golembiewski M.[2], Biesalski H.K.[1,4], Scherbaum V.[1,4]
[1]University of Hohenheim, Institute of Biological Chemistry and Nutrition (140a), Stuttgart, Germany, [2]NGO Shining Eyes, Medical Aid for Children and Socioeconomic Village Development in India e.V., Flein, Germany, [3]University of Hohenheim, Household and Consumer Economics (530A), Stuttgart, Germany, [4]University of Hohenheim, Food Security Center, Stuttgart, Germany

Objectives: This study explored infant feeding practices and health seeking behavior of Adivasi mothers participating in a long-term supplementary feeding trial of infants and young children in a community-based intervention in West Bengal, India aimed at improving the nutritional status of the index child 6-39 months.
Methods: The baseline survey was conducted in February 2015, in all 21 tribal villages in the coverage area of the activities of the NGO Bolpur Manab Jamin. In total, 288 mothers and 307 children were recruited for their hemoglobin levels and anthropometric indices. Further a questionnaire-based interview was conducted elucidating aspects related to infant feeding practices, childcare, family scheduling, and prenatal care. The HemoCue Hb201+ analyzer was used to determine hemoglobin levels.
Results: The majority of mothers belong to the Santal tribe (93.8%), are married (97.5%), have had a natural vaginal delivery (94.3%), at an age between 18 to 21 years for their first child (67.8%), and have less than secondary school attainment (89.5%). Half of mothers suffered from thinness (BMI< 18.5: 49.4%), more than half were assessed as moderately to very severely malnourished according MUAC (< 23 cm: 59.7%), and the majority were anemic (Hb< 12g/dl: 86.2%). Similarly, undernutrition was highly prevalent among the index child, with the nutritional status of mothers being related to the nutritional status of the child.
Any breastfeeding was almost universal in the study area (95.7%). The majority of children were breastfed within the first hour after birth (75.7%), were fed colostrum (67.8%), and enjoyed on demand breastfeeding (84.1%). Prelacteal feedings (6.8%) or supplementary feedings (9.4%) during the first week after delivery were rare. However, merely one third (32.9%) performed exclusive breastfeeding for six full months according to the recommendations of WHO/UNICEF. When relating to the proposed complementary feeding (CF) indicator then 89.6% of children have received CF during the first 6 to 8 months, and 63.7% of children aged 6 to 23 months fulfilled both the proposed meal frequency and dietary diversity score.
Conclusions: A poor maternal nutritional status together with home-based inappropriate infant feeding and child caring practices were common among Adivasi mothers, contributing to undernutrition and anemia in the young infant.

An examination of patterns and distribution of overweight among children in South Africa

Wanka F.A.[1,2], Jonah C.M.P.[2], May J.[2]
[1]*University of the Western Cape, Institute for Social Development, Cape Town, South Africa,*
[2]*University of the Western Cape, Centre of Excellence in Food Security, Cape Town, South Africa*

Introduction: Obesity at childhood is associated with serious health issues and the risk of premature illness and death later on in life. Hence, it is important to monitor the related trends.
Objectives: The aim of this paper was to quantify the prevalence and trends of overweight and obesity in South Africa amongst under five years of age.
Methods: A cross-sectional analysis was done using data from the South African National Income Dynamics Panel Survey for 2008, 2012 and 2017. A total number of 3234, 3637 and 4526 were aged under five years for the respective surveys. Children with weight for height greater than 2SDs based on the World Health Organisation growth standard were classified as overweight.
Results: In 2008 it was observed that overweight was 13.2% (95% CI: 11.1%, 15.7%) which later increased to 17.1% (95% CI: 15.1, 19.4%) in 2012 and a decrease of 11.7%(95% CI: 10.2%, 13.4%) was observed in 2017 nationally. Overweight is more prevalent in children age 0-23months compared to those 24 -59months. Apart from 2017, the rate was higher for boys than girls in the other two years. For all three years, overweight was higher for Black than Coloured children. For all three years, overweight was higher in the urban informal in 2008 and 2012, while in 2017 it was high in the tribal areas compared to the rural formal and urban informal.
Conclusions: The findings indicated that between 2008 and 2012, the was a sharp increase in overweight by about 3.9%. Between 2012 and 2017, a sharp decrease of roughly 5.4% was observed. However, between 2008 and 2017, the was a slight decrease in overweight of approximately 1.5%. Looking at the period of 9 years (2008 to 2017) there have been a decrease in the rate of overweight though the change is very minimal. Therefore, there is need for effective intervention programmes that can help remedy the situation.
Keywords: overweight, obesity, children, South Africa

Nutrition transition and traditional food culture changes in sri lanka: a study of the traditional food system and nutrition security

Weerasekara P.C.[1], Ginigaddara G.A.S.[2], Withanachchi C.R.[3], Withanachchi S.S.[1], Ploeger A.[1]
[1]University of Kassel, Specialized Partnerships in Sustainable Food Systems and Food Sovereignty, Faculty of Organic Agricultural Sciences, Witzenhausen, Germany, [2]Rajarata University of Sri Lanka, Faculty of Agriculture, Anuradhapura, Sri Lanka, [3]Rajarata University of Sri Lanka, Department of Archaeology and Heritage Management, Anuradhapura, Sri Lanka

Traditional Sri Lankan food has many nutritional benefits. The diet consists of mainly plant-based green leaves and is rich in grains, legumes, vegetables (plus their oils), as well as fruits, which they use in many ways. These diets mostly consist with little or no animal products. Nutritional and botanical information presented show that traditional food plants are linked with various health benefits, including protection from non-communicable diseases and micro-nutrition deficiencies. However, Sri Lankan traditional food system is changing day by day and in parallel nutrition deficiencies and malnutrition and non-communicable diseases are the most significant problems in Sri Lanka, today. The disorder of the social system, which may harm the social custom, may have a negative effect on Sri Lankan food habits and further the whole nutritional system. Therefore, the factors that underpin the dietary changes in Sri Lanka are important to be studied. This research aims to examine the Sri Lankan traditional food systems and how it has been changed over the period of the 400 years since the colonial occupation began including the main changes and their impact on current micronutrient deficiencies and non-communicable diseases. The research followed the integrated concept in ethnographic and sociological study approaches. The study examines historical literature and conducted several interviews with field experts and senior citizens in marginal areas of Sri Lanka. The study relevels that the fundamental issues to be dealt with, regarding food transition in Sri Lanka, involve income-induced diet diversification, dietary globalization, and Westernization. The new dietary habits in Sri Lanka reflect Western patterns and could be entirely different from the habits that developed locally over many generations. Present day lifestyle and related food habits of people have changed to a greater extent, and people are highly addicted to fast food with not well-known nutrient level.

Keywords: Micro nutritional deficiencies, traditional food system, non-communicable diseases, western diet, nutrition transition, Sri Lanka.

Understanding anemia in rural Bangladesh: a critical step for effective intervention design

Wendt A.S.[1], Waid J.L.[1,2], Gabrysch S.[1,3]
[1]Heidelberg Institute of Global Health, Heidelberg, Germany, [2]Helen Keller International, Dhaka, Bangladesh, [3]Heidelberg Center for the Environment, Heidelberg, Germany

Introduction: Typical Bangladeshi diets are very low in bioavailable iron; yet in various areas of the country, iron deficiency is almost non-existent due to high iron in the groundwater. Anemia, however, remains elevated. Understanding anemia etiology is vital to effectively address anemia in this population.
Objectives: To examine the etiology of anemia among women and children considering nutritional and non-nutrition factors.
Methods: We used baseline data from the Food and Agricultural Approaches to Reducing Malnutrition (FAARM) cluster-randomized trial, collected in 2015 in 96 settlements. In this analysis, we included a sub-sample of 366 non-pregnant women and 204 children (6-37 months). Blood samples were analyzed for hemoglobin, iron status (serum ferritin and serum transferrin receptor), vitamin A status (retinol binding protein (RBP)), inflammation (c-reactive protein and alpha-1-glycoprotein), vitamin B-12 status (methylmalonic acid (MMA)), and hemoglobinopathies (alpha-, beta-thalassemia, Hemoglobin E, and Hemoglobin S). Logistic regression was conducted to identify factors associated with anemia, adjusting iron and vitamin A for inflammation.
Results: Almost half of women and children were anemic (45% and 46%) though only 2% of women and 17% of children were iron-deficient (total body iron < 0 mg/kg). Almost 20% of women and 60% of children had deficient or insufficient vitamin A levels. Vitamin B-12 insufficiency (MMA: 210-410 nM) and deficiency (MMA: < 210 nM) were also high among women (48% and 27%) and children (25% and 70%). About 10% of women and children had any thalassemia or hemoglobinopathy and 5% had either beta-thalassemia or HbE. Despite low levels of iron deficiency among women, total body iron (mg/kg) was strongly associated with less anemia, as was RBP (µmol/L) (iron: OR (95% CI): 0.8 (0.7, 0.8); vitamin A: 0.5 (0.3, 0.8)). In children, total body iron and age were also protective. In both women and children, having beta-thalassemia or Hemoglobin E was associated with an increased risk of anemia. Vitamin B-12 status was not associated with anemia.
Conclusions: Although iron deficiency is not common in this study population, there remains a strong association between total body iron and anemia. Vitamin A was also strongly associated with anemia and may be a key intervention strategy as levels were low in both women and children. However, further research is still needed as a large proportion of anemia remains unexplained.

Does governance impact under-nutrition: An integrated approach to reducing underweight in children under 5 years

Woode G.[1], Birner R.[1]
[1]*University of Hohenheim, Social and Institutional Change in Agricultural Development, Stuttgart, Germany*

Objectives: To evaluate the effect of human resource capacity and expenditure on nutrition program outcomes for children under 5 years in Ghana.
Methods: A mixed method approach was used including key informants' interviews, panel data comprising anthropometric measurements of weight and age of children 0-59 months from 2014-2017 in three regions taken with their Z-score means and proportion underweight calculated. Linear Mixed-Effect modelling in SPSS was also used to estimate the effect of human resource and expenditure for nutrition program implementations.
Results: From 2014 - 2017, there was an increase in placement of key staff for nutrition programs and an increased funding for nutrition program. Nutrition counselling was tailored to the consumption of nutrient-rich value chain products for complementary feeding and for maternal diet. The results show that, the percent of children less than 5 years of age registered in well-child clinics with global malnutrition (weight-for-age) less than 2 Standard Deviation below the standard mean decreased by between 80% in Northern region to 49% in Greater Accra region. From 20% at the beginning of 2014 in northern region to 4% at the end of 2017(95%CI:-1.2021.25) Cohen's d=3.6, from 11.13% to 4.6% (95% CI: 2.89%-11.98%) in Central region representing a 59% reduction in underweight Cohen's d=4.4 while Greater Accra had a 49% reduction in underweight from 7.21% to 3.71% (95% CI: 2.81%-7.61%) Cohen's d=2.8 over the same period. However, human resource with requisite expenditure for nutrition programs, were not significant predictors of underweight in children under 5 years.
Conclusion: Our results indicate government failure among others, however nutrition related behavior change engineered by community support groups in under-served areas by promotion of nutrition-sensitive agriculture, and consumption of nutrient-rich agricultural value chain products are vital in reducing underweight in children under 5 years in the targeted regions. Therefore, improving community governance systems could be associated with improvement in nutritional status of children under 5 years in resource challenged settings.