Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training
Advancing Global Nutrition for Adolescent and Family Health:
Innovations in Research and Training

Workshop Proceedings

Rapporteur:
Anna Nicholson

Planning Committee:
Wafaie Fawzi
Chelsey Canavan
Salmaan Keshavjee

Harvard Medical School Center for Global Health Delivery-Dubai
Harvard Medical School

Department of Global Health and Population
Harvard T.H. Chan School of Public Health

Mohammed Bin Rashid University (MBRU)
Dubai Healthcare City, Dubai, United Arab Emirates

February 16-17, 2018
## Contents

1 Introduction 7
   1.1 Organization of the workshop 8
   1.2 Organization of the workshop proceedings 8

2 Child and adolescent health and nutrition interventions 9
   2.1 Anemia interventions to improve adolescent health 9
      2.1.1 Introduction to adolescent nutrition 9
      2.1.2 Anemia in adolescents 10
      2.1.3 WHO recommendations on iron supplementation 13
      2.1.4 WIFS intervention in India 14
      2.1.5 Discussion 15
   2.2 Adolescent anemia working group proposals 16
   2.3 Integrated child health and nutrition interventions 17
      2.3.1 Risks associated with poor early child development outcomes 17
      2.3.2 Research opportunities for the ARISE network 19
      2.3.3 Integrating care, stimulation/early learning, and nutrition interventions 19
      2.3.6 Early child development scale up trial in Pakistan 21
      2.3.7 Overview of integrated nutrition and stimulation interventions 22
      2.3.8 Discussion 23
   2.4 Mental health and child development working group proposals 23

3 Adolescent sexual and reproductive health interventions 25
   3.1 Interventions to improve adolescent sexual and reproductive health 25
      3.1.1 Child marriage as an outcome of adolescent reproductive and sexual health 26
      3.1.2 Interventions to prevent child marriage 28
      3.1.3 Lessons from past interventions to prevent child marriage 28
      3.1.4 Developing proposals for interventions 29
      3.1.5 Policy levers 29
      3.1.6 Discussion 30
   3.2 Creating demand for youth-friendly sexual and reproductive health interventions 31
      3.2.1 Risky sexual behaviors among adolescents in Ghana 31
      3.2.2 Teenage pregnancy and child marriage in Ghana 33
      3.2.3 Nutritional status of adolescents in Ghana 33
3.2.4 Policy framework
3.2.5 Proposed intervention to create demand for youth-friendly service
3.2.6 Discussion

3.3 Sexual and reproductive health working group proposals

4 Urban food systems and food production interventions

4.1 Impact of urban food systems on health and nutrition
   4.1.1 Urbanization and the obesogenic environment
   4.1.2 Pesticides in food systems
   4.1.3 Research background and proposals
   4.1.4 Ongoing work in India
   4.1.5 Discussion

4.2 Sustainable urban diets to improve health
   4.2.1 Food environments
   4.2.3 Food systems and environmental impacts
   4.2.4 Urban diet study
   4.2.5 Discussion

4.3 Homestead food production interventions
   4.3.1 Nutrition-sensitive interventions and programs
   4.3.2 Theory of change for homestead food production
   4.3.3 Nutrition-sensitive homestead food production project in Tanzania
   4.3.4 Impact assessment of nutrition-sensitive interventions
   4.3.5 Optimal mix of interventions
   4.3.6 Discussion

4.4 Schools and urban food systems working group proposals

4.5 Homestead food production working group proposals

5 Health and demographic surveillance systems

5.1 Longitudinal health and demographic surveillance systems
   5.1.1 Health and demographic surveillance system in Kersa and Harrar, Ethiopia
   5.1.2 ARISE study in Kersa and Harar

5.2 Longitudinal demographic surveillance systems working group proposals

6 Synthesis and ways forward

6.1 Short-term interventions factoring in limited scope and expense
   6.1.1 Market basket audit
   6.1.2 School-based surveys of food ecosystem and fruit and vegetable intake
6.1.3 Workshops with adolescents about approaching sensitive topics  

6.2 Larger interventions requiring more time and resources  
6.2.1 Integrated interventions to delay marriage, delay pregnancy, and improve nutrition  
6.2.2 Integrated two-generational intervention  
6.2.3 Interventions around anemia and/or undernutrition among adolescents  
6.2.4 Policy intervention to target fruit and vegetable consumption  
6.2.5 Smaller studies to inform school-based interventions  

6.3 Opportunities for writing and dissemination  

Appendices  
Appendix A. Workshop agenda  
Appendix B. List of workshop participants
Abbreviations

AAPH: Africa Academy for Public Health
ARISE: Africa Research, Implementation Science, and Education
ASRH: Adolescent Sexual and Reproductive Health
BMI: Body Mass Index
CHAMPS: Child Health and Mortality Prevention Surveillance
ECD: Early Childhood Development
HDSS: Health and Demographic Surveillance Systems
LHW: Lady Health Worker
LMIC: Low- or Middle-income Country
MUAC: Mid-Upper Arm Circumference
POP: Persistent Organic Pollutants
SHEP: School Health Education Program
WASH: Water, Sanitation and Hygiene
1 Introduction

On February 16th and 17th 2018, a group of international experts from a range of disciplines convened at the Harvard Medical School Center for Global Health Delivery–Dubai for the workshop Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training. The meeting was organized by the Harvard T.H. Chan School of Public Health’s Department of Global Health and Population, with support from the Center for Global Health Delivery (see Box 1 for a description of the Center’s activities). Wafaie Fawzi of Harvard T.H. Chan School of Public Health (U.S.) opened the workshop by welcoming participants and thanking the Center for hosting the meeting. Adolescent health is addressed from various vantage points, he explained, such as nutrition, sexual and reproductive health, chronic diseases, mental health, and child development. A key aim of the meeting was to collaborate toward developing concrete proposals for interventions and actions by drawing upon the experience and expertise of the assembled participants.

In 2014, the Africa Research, Implementation Science, and Education (ARISE) Network was launched with the support of the Africa Health Partnership at the school, which promotes collaborations with academic and research institutions throughout Sub-Saharan Africa, and the Harvard-affiliated Africa Academy for Public Health (AAPH), which is a regional hub for health-related research, training and education, and knowledge translation. Harvard T.H. Chan School of Public Health and AAPH have been working together for over 40 years to advance public health priorities in Sub-Saharan Africa. ARISE is a network for collaborative education and research activities in Africa that brings together colleagues and institutions from seven countries in Africa to advance training and research capacity in the region. The ARISE Network has collected data on all those dimensions of adolescent health through a uniform survey conducted in nine sites in Africa and also worked with partners to conduct the survey in India. The workshop brought together ARISE Network members and others working to advance nutrition for adolescent and family health in the ARISE region and beyond.
Box 1. Harvard Medical School Center for Global Health Delivery - Dubai

A brief overview of the work carried out by the Harvard Medical School Center for Global Health Delivery–Dubai was provided by Salmaan Keshavjee, the director of the Center and an associate professor of global health and social medicine at Harvard Medical School. The Center was created with the aim of addressing a critical gap in translating laboratory and clinical scientific advances into knowledge among communities where people live and work. An ongoing challenge in global health is finding ways to bring the fruits of modern medicine to bear on people’s lives in ways that have meaningful, population-level impact, he said. The Center was created to build on Harvard Medical School’s mission, to create and nurture a diverse community of the best people to alleviate human suffering. The Center’s work focuses on delivering care for health conditions with burdens that are compounding rapidly worldwide, but which are not receiving the urgent attention from the global health community that they so increasingly warrant. These areas of focus include diabetes, obesity, cardiovascular disease, mental health, access to surgical care, and infectious diseases including tuberculosis and hepatitis C virus. The Center’s guiding rubric is to address maternal and child health within each of these areas of focus. The Center brings together experts from around the world for meetings and workshops, with outputs ranging from proceedings to policy briefs that are shaping policy and driving action far and wide, said Keshavjee.


1.1 ORGANIZATION OF THE WORKSHOP

The two-day workshop featured eight presentations related to advancing global nutrition for adolescent and family health. Topics included anemia, adolescent sexual and reproductive health, early childhood development, urban food systems and diets, homestead and school-based food production interventions, and health and demographic surveillance systems. Smaller working group sessions were interspersed throughout the workshop, in which participants generated proposals for intervening in each of those six focus areas. The workshop concluded with a synthesis and group discussion.

1.2 ORGANIZATION OF THE WORKSHOP PROCEEDINGS

The proceedings of the workshop are structured into six chapters. The second chapter summarizes the presentations and working group discussions focused on child and adolescent health and nutrition. Adolescent sexual and reproductive health interventions, presentations, and working group discussions are presented in the third chapter. The fourth chapter describes presentations and discussions on urban food systems and food production interventions, while the fifth chapter covers health and demographic surveillance systems. The sixth chapter provides a summary of the final group synthesis and discussion of ways forward to develop interventions and to publish and disseminate research.
2 Child and adolescent health and nutrition interventions

2.1 ANEMIA INTERVENTIONS TO IMPROVE ADOLESCENT HEALTH

In his presentation, Chris Sudfeld, Assistant Professor at the Harvard T.H. Chan School of Public Health (U.S.), provided a brief introduction to key concepts in adolescent nutrition before focusing on the prevalence and treatment of anemia in adolescents.

2.1.1 Introduction to adolescent nutrition

Sudfeld opened by presenting Figure 21, which depicts the life cycle approach to nutrition. It illustrates the effects across the cycle from low birth weight to adult noncommunicable diseases. He noted that there has been much research focused on the first five years of life—that is, babies with low birth weight and associated risks of mortality and impaired mental health—as well as in the pregnancy space and the impact on child mortality. However, he drew attention to the component of the cycle related to adolescent nutrition and its effects on adolescents who become pregnant, including the impact on cognitive development. Iron deficiency is also associated with fatigue and loss of productivity, he added.

Figure 1. Nutrition through the life cycle

Note: LBW = low birth weight
Source: Sudfeld, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

1 Figure source: Ahmed et al. Ann Nutr Metab 2012
To set the stage, Sudfeld presented some of the data on the prevalence of underweight and overweight males and females according to the ARISE survey in five sites in Africa (see Table 21). He noted that undernutrition was more common in most of the communities sampled, but there is a transition underway toward greater proportions of overweight people. However, Ghana is an outlier in which the proportion of overweight females is three times as large as the proportion of underweight females.

Table 1. Proportions of overweight and underweight males and females (ARISE survey preliminary data)

<table>
<thead>
<tr>
<th>Site</th>
<th>Sex</th>
<th>% Underweight (95% CI)</th>
<th>% Overweight (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harar, Ethiopia</td>
<td>Male</td>
<td>24.4 (20.8, 28.4)</td>
<td>7.4 (5.4, 10.1)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>18.1 (15.1, 21.5)</td>
<td>8.9 (6.8, 11.6)</td>
</tr>
<tr>
<td>Kersa, Ethiopia</td>
<td>Male</td>
<td>6.6 (4.8, 9.1)</td>
<td>8.0 (5.9, 10.6)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>7.3 (5.2, 10.2)</td>
<td>8.0 (5.8, 11.1)</td>
</tr>
<tr>
<td>Ningo Prampram, Ghana</td>
<td>Male</td>
<td>10.3 (7.2, 14.5)</td>
<td>7.8 (5.2, 11.6)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>5.2 (3.3, 8.2)</td>
<td>14.0 (10.7, 18.0)</td>
</tr>
<tr>
<td>Ibadan, Nigeria</td>
<td>Male</td>
<td>26.0 (21.6, 30.9)</td>
<td>3.0 (1.5, 5.4)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>12.2 (9.3, 15.7)</td>
<td>7.8 (5.6, 10.8)</td>
</tr>
<tr>
<td>Dodoma, Tanzania</td>
<td>Male</td>
<td>15.5 (12.7, 18.8)</td>
<td>4.0 (2.6, 6.0)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>12.8 (10.5, 15.6)</td>
<td>6.1 (4.5, 8.1)</td>
</tr>
</tbody>
</table>


2.1.2 Anemia in adolescents

Much of Sudfeld’s presentation focused on anemia in adolescents. He reported that around 1.6 billion people worldwide are anemic, or around 23% of the global population. However, adolescent girls are drastically overrepresented in this population. The prevalence of anemia among adolescents varies widely in different regions of the world.

It affects around half of non-pregnant adult women (aged 15-49 years) in south Asia (47%) and in central and west Africa (48%), both of which are very large populations. The prevalence of anemia is lower in Latin America (18%-19%) and in East Africa (28%). Even within the ARISE sites, there is a gradient in the amount of anemia seen.

2 Stevens et al Lancet Glob Health 2013
Box 2. Critical transitions in adolescence

Sudfeld remarked that adolescence is a time of critical transitions, which is illustrated by changes in the top-ranking causes of death among adolescents by gender and age group worldwide. For males aged 10-14 years, the top three causes of death are road injury, drowning, and lower respiratory infection; for females in the same age group, the top three causes are lower respiratory infections, diarrheal diseases, and meningitis. This indicates that younger adolescents (especially females) tend to be affected by communicable diseases, but there is a dramatic shift in causes of death for adolescents aged 15-19 years. For females, the most common causes of death are maternal/pregnancy-related conditions, self-harm, and road injury and for males, the most common causes are road injury, self-harm, and interpersonal violence. Sudfeld noted that across both genders, mental health (self-harm) emerges as the second most common cause of death among older adolescents that is not ranked in the top five causes of death for either gender among the younger adolescents. This reflects the transition in the risks faced by adolescents as they grow older and underscores the need for targeted interventions that are tailored to specific age groups and gender groups. The same intervention will probably not have the same impact or require the same type of messaging to reach these different groups. He added that interventions will likely need to be country- and setting-specific to achieve the greatest impact. These decisions are critical in designing and implementing interventions targeting adolescents in the domain of sexual and reproductive health.


Anemia is a reduction in the number of red blood cells or in the quality or quantity of hemoglobin. It has many possible causes, ranging from genetic hemoglobin disorders to infectious diseases to nutrition. Sudfeld focused on iron deficiency, which is a nutritional cause of anemia in most settings. Adolescent girls are at particular risk for anemia due to menstrual blood losses, rapid growth with expansion of the red cell mass, and increased tissue iron requirements that make them particularly vulnerable to iron deficiency compared to their male counterparts. The foremost effect of anemia is fatigue, followed by reduced productivity (by an estimated 30%) and reduced cognitive performance. The effects of anemia place a huge economic burden on societies around the world. A study in Bangladesh estimated the economic cost of anemia to be 7.9% of GDP due to the loss of productivity. Anemia among adolescents can also contribute significantly to disability-adjusted life years (DALYs). Productivity loss due to iron-deficiency anemia is the leading cause of DALYs among adolescent females aged 10-14 years (1161 DALYs per 100,000) and 15-19 years (836 per 100,000). Anemia can also be a cause of death (see Box 21) as well as a barrier for staying in school because of its cognitive effects.

Sudfeld provided an overview of the nutrition-related components of the World Health Organization’s Global Accelerated Action for

---

3 Other causes related to nutrition include folic acid deficiency, vitamin B12 deficiency, vitamin A deficiency, and protein-energy malfunction.
4 Christian P 2005; UN/SCN 2004
5 Followed by lower respiratory infections, diarrheal diseases, anxiety disorders, and meningitis in those aged 10-14 years and followed by depressive disorders, maternal conditions, self-harm, and anxiety disorders among those aged 15-19 years.
the Health of Adolescents (see Figure 2). It contains 27 interventions to be implemented based on the prevalence of the risk factors in a particular community. WHO does not indicate what constitutes high risk or what requires intervention, so countries themselves decide which interventions to implement based on their own data. He noted that the guidance is very broad and the method and delivery of interventions is not very clear. Within the focus area of noncommunicable diseases, nutrition, and physical activity, for example, it is unclear which noncommunicable diseases are being referred to, how to prevent them, or how to detect them. The same applies to the recommendation regarding anemia: prevention, detection and management of anemia, especially in adolescent girls.

Figure 2. Global Accelerated Action for the Health of Adolescents interventions by focus area

<table>
<thead>
<tr>
<th>Positive development</th>
<th>Unintentional injury</th>
<th>Violence</th>
<th>Sexual and reproduction health, including HIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescent-friendly health services</td>
<td>Laws on drinking age, blood alcohol concentration, seat-belt and helmet wearing, graduated driver licensing</td>
<td>INSPIRE strategies to prevent and respond to all forms of violence against children and adolescents</td>
<td>Comprehensive sexuality education</td>
</tr>
<tr>
<td>Health-promoting schools</td>
<td>Traffic calming and safety measures</td>
<td>Implementation and enforcement of laws: banning violent punishment, criminalizing sexual abuse and exploitation of children, preventing alcohol abuse, limiting youth access to firearms and other weapons</td>
<td>Information, counselling and services for comprehensive sexual and reproductive health</td>
</tr>
<tr>
<td>Hygiene and nutrition interventions</td>
<td>Child online protection</td>
<td>Population, community-based and individual level interventions to promote behavioral change related to safe driving and good laws to encourage behavioral change</td>
<td>Prevention and response to harmful practices, such as female genital mutilation and early and forced marriage</td>
</tr>
<tr>
<td>Child online protection</td>
<td>Prevention and management of anemia, especially for adolescent girls</td>
<td>Prevention and detection of anemia, iron supplementation where appropriate</td>
<td>Prevention and treatment of adolescent mental health and well-being</td>
</tr>
<tr>
<td>Adolescent participation and interventions to promote competence, confidence, connection, character and care</td>
<td>Adolescent participation and interventions to promote behavioral change related to safe driving and good laws to encourage behavioral change</td>
<td>Prevention, detection and treatment of noncommunicable diseases</td>
<td>Parental and caregiver support through home visits, community approaches and comprehensive programmes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment and rehabilitation of children with congenital abnormalities and disabilities</td>
<td>Income and economic strengthening; cash transfers, group saving and loan, microfinance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assessment of management of adolescents who present with unintentional injury, including alcohol-related injury</td>
<td>Response and support services: screening and interventions, counselling and therapeutic approaches, programmes for juvenile offenders, foster care interventions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Education and life skills: increasing school enrolment, safety and enabling school environment, life and social skills training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assessment of management of adolescents who present with unintentional injury, including alcohol-related injury</td>
<td>Education and life skills: increasing school enrolment, safety and enabling school environment, life and social skills training</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communicable diseases</th>
<th>Noncommunicable diseases, nutrition and physical activity</th>
<th>Mental health, substance use and self-harm</th>
<th>Conditions with particularly high priority in humanitarian and fragile settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention, detection and treatment of communicable diseases, including tuberculosis</td>
<td>Structural, environmental, organizational, community, interpersonal and individual level interventions to promote healthy</td>
<td>Care for children with developmental delay</td>
<td>Assessment of conditions and ensuring adequate nutrition for adolescent populations groups according to age, gender,</td>
</tr>
<tr>
<td>Routine vaccinations, e.g. human papillomavirus, hepatitis B, diphteria-tetanus, rubella, measles</td>
<td>Noncommunicable diseases, nutrition and physical activity</td>
<td>Responsive caregiving and stimulation</td>
<td>Psychosocial support and related services for adolescent mental health and well-being</td>
</tr>
<tr>
<td>Prevention and management of childhood illnesses, including malaria, pneumonia, meningitis and diphtheria</td>
<td>Prevention, detection and treatment of noncommunicable diseases</td>
<td>Parental skills training, as appropriate, for managing behavioral disorders in adolescents</td>
<td>Parental skills training, as appropriate, for managing behavioral disorders in adolescents</td>
</tr>
<tr>
<td>Case management of meningitis</td>
<td>Prevention, detection and treatment of noncommunicable diseases</td>
<td>Structural, environmental, organizational, community, interpersonal and individual level interventions to prevent substance use</td>
<td>Structural, environmental, organizational, community, interpersonal and individual level interventions to prevent substance use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Detection and management of hazardous and harmful substance use</td>
<td>Structural, environmental, organizational, community, interpersonal and individual level interventions to prevent substance use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Structural, environmental, organizational, community, interpersonal and individual level interventions to prevent substance use</td>
<td></td>
</tr>
</tbody>
</table>

Source: Sudfeld, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

---

6 World Health Organization 2017b
7 Figure source: World Health Organization 2017b
2.1.3 WHO recommendations on iron supplementation

WHO recommendations on iron supplementation span three different guideline documents, said Sudfeld. The three recommendations include:

- Daily iron supplementation in adult women and adolescent girls when anemia prevalence is >40% \(^8\)
- Intermittent iron supplementation in adult women and adolescent girls when anemia prevalence is >20% \(^9\)
- Intermittent iron supplementation in school-age children when anemia prevalence is >20% \(^10\)

2.1.3.1 Daily iron supplementation in adult women and adolescent girls

This WHO guideline suggests daily iron supplementation (30-60 mg elemental iron tablets) for three consecutive months in a year for menstruating non-pregnant adult women and adolescent girls when the prevalence of anemia is greater than 40%. Sudfeld noted that this applies to some settings in India, but in East Africa, most settings (other than rural communities) will likely not have a prevalence above the 40% threshold. The guideline does not suggest how to deliver the supplementation or which three months of the year it should be given.

According to this guideline, WHO has four research priorities in this area. The first is to determine the optimal dose, schedule, and duration of iron supplementation; the effect of different doses and duration of iron supplementation on different severity, prevalence or causes of anemia in all WHO regions. Another stated priority is to examine the effect of adding other micronutrients to the iron supplement on hemoglobin concentrations and the prevalence of anemia. He noted that even if every woman in this group is supplemented, there are remaining causes of anemia that need to be addressed (e.g., hook worm infection or vitamin B12 deficiency). He said that a study adding the micronutrient B12 to the iron supplement and comparing it to the effect of iron supplementation alone could have either a large or a null effect, depending on the prevalence of B12 deficiency in the study group. The third priority is implementation research on effective behavior-change strategies for sustained adherence and delivery mechanisms. He emphasized that this supplementation is being given to healthy, young, non-pregnant girls. Ensuring uptake by a community—particularly for an intervention like iron, which is associated with pregnancy—can be a particular challenge. Supplementation also has side effects including nausea, vomiting, and black stool that can cause concern in the community about the effect of the medication on these adolescent girls. WHO’s fourth stated research priority is cost, cost–benefit, and the feasibility analysis of the distribution of iron supplementation to be taken daily or intermittently among menstruating adult women and adolescent girls. He added that new distribution mechanisms will likely be required, for example, through schools and community health workers in parallel to reach in- and out-of-school adolescents.

2.1.3.2 Intermittent iron supplementation in adult women and adolescent girls

The second WHO guideline concerns intermittent iron and folic acid supplementation for all menstruating adolescent young girls and adult women in settings where anemia rates are greater than 20%. Sudfeld noted that that iron supplementation can increase the risk of malaria and its severity. Therefore, in ARISE settings in Africa in malaria-endemic areas, for example, the provision of iron and folic acid supplements should be made in conjunction

\(^8\) World Health Organization 2016
\(^9\) World Health Organization 2011a
\(^10\) World Health Organization 2011b
\(^11\) For settings without prevalence data, the guidelines suggest considering proxies for high risk of anemia.
with adequate measures to prevent, diagnose, and treat malaria. This guideline has its own set of research priorities that are not directly aligned. The first priority is to research the benefits of intermittent iron on work, productivity, and pregnancy outcomes. He noted that they have not looked at how these weekly interventions may affect schooling for adolescent girls. Other priorities include the most effective and safe weekly dose of iron and folic acid to improve folate status and prevent neural tube defects, the effects of adding other vitamins and minerals on anemia and other outcomes, and the optimal time interval between periods of supplementation. A period of 3 months on and 3 months off is relatively challenging to implement, said Sudfeld.

2.1.3.3 Intermittent iron supplementation in school-age children

The guidelines suggest schemes for intermittent iron supplementation in preschool and school-age children when anemia prevalence is greater than 20%. Three months of weekly supplementation are recommended, followed by three months of no supplementation and restarting the cycle. The recommended supplements are 25 mg of elemental iron (drops/syrups) per week for preschool-age children (24-59 months) and 45 mg of elemental iron (tablets/capsules) per week for school-age children (5-12 years). If feasible, supplementation could be given throughout the school year. Again, the guidelines do not provide any specific information about when the supplements should be administered or why, added Sudfeld.

2.1.4 WIFS intervention in India

To illustrate some of the challenges related to weekly iron and folic acid supplementation, Sudfeld described the WIFS intervention implemented in India. The goal was to reduce the prevalence and severity of anemia in the adolescent population by targeting two groups: school-going adolescent girls and boys as well as adolescent girls who were not in school. Together, the two target groups were estimated to represent 108 million adolescents in India. The intervention comprised weekly blue 100 mg elemental iron and 500µg folic acid, deworming with albendazole every 6 months, screening and referral for anemia, and general nutrition and health counseling. He noted that the dose of iron was much larger than the recommended dose and probably not optimal for young people or pregnant women. For the first group (school going) the iron was given in schools. For adolescent girls not in school, the iron was given through Anganwadi centers. The Ministry of Health provided the medications. Implementation may not be universal across all communities because of a range of barriers, including issues with parents and the occasional side effects of iron supplementation. Black stool, nausea, giddiness, heartburn and vomiting have been often highlighted by the India media and have contributed to poor uptake of WIFS in some communities.

Sudfeld concluded by suggesting that lessons learned from the Indian experience could be transferred to settings in Africa for adolescent anemia, although some components will differ. He suggested looking at the optimal dose and timing of WIFS and/or daily iron supplementation depending on anemia prevalence, given the various approaches suggested in the WHO guidelines. He also recommended considering whether a school-community model would work in ARISE settings by linking the school and community to deliver the interventions to in-school and out-of-school adolescents. The delivery mechanisms will likely be different for these two groups of adolescents, he added, which further complicates matters.

12 Anganwadi centers are a part of the Indian public healthcare system established to combat child hunger and malnutrition; the centers provide basic health care in Indian villages.
2.1.5 Discussion

Lindsay Jaacks, assistant professor at the Harvard T.H. Chan School of Public Health (U.S.), asked if the teachers observe the children taking the blue tablets. Anamitra Barik of the Society for Health and Demographic Surveillance (West Bengal, India) clarified that the recommendation is that tablets should be taken in school, but many schools lack drinking water and the children often prefer to take the tablet home. Sudfeld noted that children may throw away the tablet on their way home. He suggested considering ways to improve this intervention as well as translating lessons learned from the India experience to create beneficial interventions in other settings.

Salmaan Keshavjee, director of the Harvard Medical School Center for Global Health Delivery—Dubai was struck by the similarity of the conversation to those about tuberculosis (TB) and the dissimilarity to those about HIV, with the latter’s focus on trust, compassion and treatment literacy. HIV patients rarely throw away medications they are given; they know what they need to take and they take them. TB patients, on the other hand, often do not know what they are taking and prematurely stop taking medications before the course is complete. He wondered about the reasons for this disparity. Wafaie Fawzi, Harvard T.H. Chan School of Public Health, commented that HIV is life threatening and for a long time there were no treatments available. There is not similar pressure upon pregnant women or people who perceive themselves as healthy, for example. Keshavjee asked if the iron intervention involves a literacy component, and Sudfeld replied that the messaging around weekly iron and folic acid supplements is very important, because the intervention involves adolescents and their parents. In West Bengal, they are considering how the community could best receive these messages.

Keshavjee suggested drawing upon messaging strategies used around human papillomaviruses (HPV) vaccination, in which people seem to respond if they are convinced that something bad will happen to them 15 to 20 years later if they are not vaccinated. Sudfeld commented that many program evaluations in certain districts of India have shown that coverage is less than 50% for the intervention. An ongoing mixed methods quantitative and qualitative study in West Bengal is aimed at understanding how this all comes together. Although it is likely very community specific, there is probably a general strategy that involves the community, parents and the local groups to get these messages across. “The pills are there. It is just getting them to the right people,” he said.

Andy McDowell of Tulane University (U.S.) asked if systemic options have been explored around the potential roles of fortification of food, noting that experience in tuberculosis reveals that pills do not always work in expected ways. Sudfeld replied that iron fortification is an option, but its effectiveness is contingent upon factors like who consumes fortifiable foods, whether supplement programs exist, and whether the country has a program of universal iron fortification. Rajesh Kumar Rai of the Society for Health and Demographic Surveillance (West Bengal, India) noted iron fortification studies are ongoing in India, but it can be difficult to gain communities’ cooperation.

Emily Smith of Harvard T.H. Chan School of Public Health (U.S.) asked about the etiology of anemia and whether Sudfeld was confident in the estimate that 50% of anemia is responsive to iron supplementation. Sudfeld said that this estimate may hold in some settings but not in others—it depends upon the iron intake in the background population. In ARISE settings such as Ethiopia, for example, large questions remain about iron intake and etiology of anemia. He noted that good etiology studies have not yet been carried out among adolescents, so the ARISE group is currently making projections based on adult surveys.

Jaacks asked about the relationship between dietary iron intake and anemia and Sudfeld
referred to studies that show associations between higher intake of iron and lower risk of anemia. She noted that some vitamin intake studies have not found a correlation between intake and status. Sudfeld said that vitamin B12 is a contributor, depending on the background of iron deficiency and the prevalence causes of anemia in populations. Participants discussed the appropriate dose and rationale for the iron supplement dose of 100 mg. Seth Adu, University of Ghana, suggested that because the intake of the iron tablets is so poor, the rationale for providing larger doses is to compensate for missed doses. Fawzi noted that the global recommendation of 120 mg was reduced to 60 mg based on studies that have taken such factors into account. He noted that many pregnant women do not receive supplementation until around 20 or 30 weeks, which is a short window in which to intervene so providing a bigger dose (assuming adherence) may have an impact. He suggested that if adherence is not high, then reassessment and lowering the dose (and side effects) can lead to better compliance and the total collective dose will be much higher.

2.2 ADOLESCENT ANEMIA WORKING GROUP PROPOSALS

Reporting out for working group on adolescent anemia, Chris Sudfeld said the group focused on how to strengthen and translate a program that is running in India to settings in Tanzania and Uganda. The first intervention suggested by the group was to pilot a weekly iron and folic acid supplementation program in schools only. He explained that the Indian program has an in-school arm and an arm to reach adolescents who are out of school through the Anganwadi workers who give out tablets. In both Uganda and Tanzania, however, community health workers can only give advice and are not allowed to deliver any products (such as medicines or tests) directly to the home. Therefore, the community health worker component would not currently be viable in those two countries. To apply some of the lessons learned from the Indian setting about framing the overall benefit of the supplementation for adolescents not in terms of anemia, which they may not understand, but in terms of the increases in productivity and learning, He suggested implementing a math test before and after the intervention to highlight on the productivity benefits instead of the clinical benefits. The intervention should be carried out through close engagement with the ministries of health and education in both countries, because it is a health intervention carried out in school settings. The group also discussed colors and marketing, said Sudfeld. The pills provided in the India intervention are blue to differentiate them from the maternal iron/folic acid dose. However, he noted that using the same tablets for both maternal and adolescent supplementation may not be an issue in the communities in Uganda or Tanzania.

The second proposed intervention was a head-to-head trial of the iron plus folic acid supplementation versus a biofortified model in terms of sustainability. The idea is to provide biofortified maize and beans to one arm in the school intervention to compare the cost of providing biofortification versus the cost of providing the iron and folic acid supplements. Currently, the school lunches are purchased by tender by the school district from the lowest bidder, which is usually a private company. He noted that the intervention will likely involve cheaper, non-fortified version of the products in both settings. However, this will set up the potential for entering the market with a private/public mix to provide school lunches. He noted that in India, certain schools already offer iron-fortified rice that could be used as a comparator for the rice and beans and also offers an opportunity to improve the program in India. Sudfeld said that the group also discussed implementing an intervention in Uganda and Tanzania to assess the safety of providing iron supplementation given that it can increase

---

14 He noted that Ghana is starting a weekly supplementation program that is piloting in 5 districts. In Ethiopia, the etiology of anemia is not well understood, so an etiology study would be required before implementing any weekly iron/folic acid supplementation pilot.
the risk of malaria. He added that there is the potential for an etiology study in Ethiopia.

Sudfeld clarified that in the second intervention, they would try to increase the bioavailability and absorption of iron with citrus foods or other sources of vitamin C. When asked about the effectiveness of biofortified foods, he cited a small study done with biofortified millet in India, which showed increased levels of iron. He added that in Rwanda there are beans with more bioavailable iron in them, which have also showed increased iron levels and increased hemoglobin in school children. They would also consider using an iron-fortified bouillon cube, which may be a lower cost option that is easier to implement. He also clarified that the intervention would involve a 60-mg dose of iron (as is being carried out in Ghana) and that depending upon the setting, vitamins B, C, E, and/or D might be added to the intervention. However, that would require testing the effectiveness of iron supplementation versus iron plus additional supplements, especially because weekly iron has not been tested in trials among adolescents. In areas with seasonal malaria, they might also test the interventions during the malaria season and outside the malaria season.

2.3 INTEGRATED CHILD HEALTH AND NUTRITION INTERVENTIONS

In her presentation, Aisha Yousafzai of Harvard T.H. Chan School of Public Health (U.S.) surveyed evidence about the risks for poor early childhood development (ECD). She provided an overview of integrated child health and nutrition interventions to promote ECD, with the view to informing the design and evaluation of interventions to promote early childhood and adolescent health and development.

The development of the brain is at its most rapid in the first two to three years of life, Yousafzai said, during which time the foundations of a person’s physical health, learning, behavior, and emotional health are established. The development of higher cognitive function and social and emotional function persists throughout the adolescent period and into a person’s early twenties; this period may be different for young men and women. During this time, it is important to plan interventions taking into account strategies that are informed by the stages of maturity and development of adolescent brains to better understand the contributors to increases in risk-taking behaviors as well as how social relationships influence their decision making.

2.3.1 Risks associated with poor early child development outcomes

An estimated 250 million children around the world are not meeting their developmental potential by the age of five years due to an inadequate nurturing environment, including 60% or more children in many countries across Africa. There are significant inequalities and resulting differences in the numbers of children who are at risk of poor development between and within countries, Yousafzai added. Yousafzai explained that although the development of the brain is robust and shaped by a genetically driven blueprint, the environment and early experiences within pregnancy, infancy, and childhood all affect the quality of the brain’s functioning in relation to physical, mental, cognitive, and social-emotional health. Research has demonstrated how the nutrition and health environment, such as malnutrition and poor physical and/or caregivers’ mental health, can influence a developing brain and affect development outcomes. However, less is known about the risks of the physical environment that the child is exposed to, such as indoor pollution and heavy metal pollutions like lead. There is an association between these types of environmental risks and child development outcomes, but it warrants more investigation. In the context of the child’s social environment, much is known about early learning opportunities for preschool-aged children, but less about influences in the first three years of life. The social environment is also ripe for further research into factors such as
as chronic poverty, inadequate stimulation, early learning opportunities, low quality of nurturing care, displacement, unstable relationships, violence, abuse, and neglect.

Much attention has been focused upon biological risks compared with psychosocial risks, said Yousafzai, but understanding the connection between the two types of risks and associated interventions is critical. Biological risks include malnutrition, low birth weight/Intra-uterine growth restriction, infectious illnesses, and heavy metal exposures. Psychosocial risks include:

- Inadequate developmental stimulation and early learning opportunities
- Lack of responsive and nurturing care
- Maternal depression
- Family distress
- Maltreatment and neglect
- Violence
- Institutional care
- Food insecurity

Along the life course, these risks can impact a child’s development outcomes as well as growth, quality of care, uptake of health services, and compliance with interventions like micronutrient supplementation. Those kinds of interconnections between biological and psychosocial interventions can be bridged if more attention is paid to them, she added. As the number of risks a child is exposed to increases, they become more detrimental to the child’s wellbeing and developmental outcomes. Data from Guatemala indicate that as the number of risk factors increases from one to eight, academic attainment as measured by standardized scores decreases significantly.16

Modeling these risks and protective factors to better understand their impact on development in the life course is needed, noted Yousafzai. This needs to be improved by considering how each individual risk drives cognitive or social-emotional decline over the life course, which can be used to identify specific windows of opportunity that have the greatest potential for specific interventions. This should be considered within the paradigm of life course interventions and bundling integrated interventions. Inequalities are established early, so intervening early and promoting protective factors can catalyze a better life development trajectory in terms of health, learning and social-emotional outcomes. However, the design of interventions must take into account the risks and developmental changes that occur during the life course. Figure 23 illustrates the differing trajectories of brain and behavioral development as a function of exposure to risk and protective factors. Childhood interventions are important and can generate high economic and health returns, but they can only be optimized if the interventions span the life course. Early parenting interventions are critical, but so are parenting interventions in middle childhood and as young people transition across early adolescence, late adolescence, and then into youth/early adulthood. Early childhood interventions are not inoculations for life in terms of the protection they offer, she cautioned; increased numbers of risks are associated with increased negative life outcomes for young people. A study in the U.S. found that the odds of behavioral problems increased with every additional early adverse experience.17

Experiencing four or more risk factors is a serious risk factor for behavioral and mental health disorder outcomes, she added, which reflects the importance of longitudinal tracking.

---

17 Greeson et al American journal of community psychology 2014

Figure 3. Trajectories of development as a function of exposure to risk and protective factors

Source: Yousafzai, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

2.3.2 Research opportunities for the ARISE network

Yousafzai outlined some potential research opportunities for the ARISE network. To better model risks and protective factors on ECD for children in different contexts of adversity, she suggested intervening and measuring early adversity to predict mental health and social outcomes for young people, for example. She noted that research largely comes from only a handful of countries and from only four or five settings in low- and middle-income countries. More research is needed to better understand associations of risks on ECD (e.g., opportunities for early learning, psychosocial environment, physical environment such indoor air pollution, heavy metals, and water, sanitation and hygiene [WASH]). Further research is also needed to elucidate the timing of exposure and mechanisms on ECD (e.g., quality of caregiving environment, nutrition-related factors); better understanding the pathways—beyond mere association—will be important to improve nutrition and ECD outcomes. Many associations have been established for nutrition deficits and cognitive/learning outcomes, but fewer for motor and social-emotional development. To better understand the early environment and longer-term outcomes on development, behavior, and mental health will require being able to unpack nutrition and understand which, when, and how micronutrients and interventions impact the life course. However, it is recognized nutrition inputs alone are insufficient to improve ECD outcomes.

2.3.3 Integrating care, stimulation/early learning, and nutrition interventions

Turning to nutrition and stimulation/early learning interventions, Yousafzai introduced the essential components of nurturing care to promote health, development, and protection: health, nutrition, responsive caregiving.
security and safety, and early learning. For a young child to thrive, all of these inputs need to work well together. Nutrition interventions might work through improving the parent-child interaction to directly impact the child’s health and learning ability, or through reducing morbidity so the child is able to better respond to early learning opportunities. A meta-analysis of postnatal nutrition interventions and cognitive development suggests that nutritional status tends to have a smaller impact on learning development and that macronutrients tend to fare better than micronutrients in terms of the impact on cognitive development. There is less data on other types of development outcomes, which underscores the need to improve the quality of nutrition interventions and how they are implemented. This type of implementation research will be needed to have a greater impact on development outcomes. She added that it also draws attention to the fact that nutrition alone is not sufficient to produce the learning and emotional health outcomes desired for young children and adolescents. Stimulation interventions that provide more direct opportunities for communication and learning for young children are a more direct pathway to those desired outcomes, said Yousafzai (see Figure 24). Data from effectiveness trials on stimulation interventions and cognitive development demonstrates that the impact is consistently a bit greater than nutritional interventions. This also highlights the need for more implementation research around how to optimize the outcomes on cognitive development.

Figure 4. How stimulation might affect mental development

Source: Yousafzai, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

---

19 Black et al The Lancet 2017
20 Prado et al Nutr Rev 2014
21 Overall impact: Cohen’s d 0.076 (95% CI 0.019, 0.13); macronutrients: Cohen’s d 0.14 (95% CI 0.067, 0.27); MMN: Cohen’s d 0.082 (95% CI -0.012, 0.18); single nutrients: Cohen’s d 0.058 (95% CI -0.0015, 0.12)
22 Larson et al Matern Child Nutr 2017
23 Impact: Cohen’s d 0.42 (95% CI 0.36, 0.48)
24 Aboud et al Annu Rev Psychol 2015
25 Figure source: Larson & Yousafzai Oral Presentation, Micro-Nutrient Initiative Conference (Ethiopia, June 2014)
2.3.4 Early child development scale up trial in Pakistan

As an example of integration, Yousafzai described an early child development scale up trial in Pakistan which bundled new interventions to promote ECD into the Lady Health Worker (LHW) program. The LHW program was already providing a standard set of health interventions including family planning and basic nutrition education through targeted messaging around feeding young children and iron/folic acid supplementation for pregnant women. The goal was to strengthen the program’s existing work in young child nutrition by improving the quality of the counseling, responsive feeding messages, and the distribution of multiple micronutrient supplementation as well as introducing early learning and parenting interventions.

The trial was carried out in a LHW program in Sindh, Pakistan, to look at the benefit of that integration in terms of development outcomes and growth outcomes for young children; the implementation research element aimed to evaluate the feasibility and cost of integrating interventions to strengthen ECD outcomes. The design was a pragmatic cluster-randomized factorial effectiveness trial among 1489 mother-infant dyads enrolled into one of four groups and followed from birth to 2 years: standard LHW services (control); responsive stimulation; enhanced nutrition; and responsive stimulation plus enhanced nutrition. The intervention was delivered by the LHWs, whose schedule was not changed (i.e., monthly individual household contact along with a monthly group meeting for those who attend). The target was the mother and trying to change her practices to benefit the child by improving responsive interactions, stimulation, opportunities to provide learning for the child, and her own problem solving. Through that pathway, they hoped to see improvement in development and growth.

At the end of two years, they saw significant benefits in children’s cognitive, language, and motor development. The effect was greater for the groups receiving responsive stimulation (combined or alone), but there were no additive or synergistic benefits of the combined package on development outcomes. The children were followed up at age 4 and the benefits have been sustained two years after the intervention (analysis is ongoing for the age-eight follow up). While they did see improvement in feeding practices (more appropriate breastfeeding, increased food frequency, and dietary diversity), there was not an observed impact of enhancing the quality of the nutrition intervention on child growth at 2 or 4 years. This points to the need for other interventions that may help, including birth spacing and improving coordination (one-third of the houses are food insecure) with other systems that could improve child growth. Figure 25 illustrates the impact of responsive stimulation on the quality of the early learning environment and the quality of mother-child interaction, both of which are associated with development outcomes as well as with improved maternal health, mental health, and child growth outcomes.
2.3.5 Overview of integrated nutrition and stimulation interventions

Yousafzai concluded with an overview of what is known about integrated nutrition and stimulation interventions.

We know that nutrition interventions promote early child growth and feeding practices. Stimulation (responsive care) can support feeding practices, but it is not believed to support growth outcomes at all. Nutrition interventions have small impacts on child cognitive development, while stimulation interventions have moderate impacts on cognitive development. Evidence around additive benefits is limited because few studies have been designed to test the independent and additive benefits of interventions. However, she emphasized that there is no evidence of harm as a result of combining interventions. Integrated research in child health often deals with a host of inputs but only one outcome of interest, or involves one intervention in the hope it will benefit multiple outcomes. There is limited evidence on integration of stimulation with nutrition on children with severe acute malnutrition as well as limited evidence on longitudinal impacts of either intervention on developmental trajectories. This reflects the importance of being more thoughtful in how packages of interventions are combined.

Yousafzai highlighted a set of key research questions going forward. The first is to determine effective models for bundling and integrating child health, nutrition, and development interventions. The second is to better understand common pathways of care for child nutrition, health and development outcomes. The quality of interactions between parents and young children and targeting those caregiving levels are critical for changing a host of outcomes. The third is to identify effective models of integrated care for targeted populations (e.g., preterm/at risk infants, food insecure contexts, severe acute malnutrition); very few studies have been carried out to date. The fourth is to explore models of integrated

Note: RS = responsive stimulation; EN = enhanced nutrition
Source: Yousafzai, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 201827

---

27 Yousafzai et al Pediatrics 2015
nutrition and development care in health facilities. Most data come from community health services, so she suggested exploring the potential to intervene in primary health care facilities. Simply from a value point of view, she added, parents trust what doctors and nurses say and being able to reinforce messages consistently across the health service spectrum is important.

2.3.6 Discussion

Dhillon asked about family structures—that is, whether families tended to be nuclear or multigenerational, and whether structural differences were integrated into the interventions. Yousafzai said that the majority of interventions targeted the mother or the primary female caregiver in the household. However, they are exploring the potential additional benefits of targeting fathers and/or couples by comparing groups working only with mothers to groups working with mothers and fathers. They are looking at the child outcomes and also the caregiving pathways; that is, how does the intervention benefit the mental health of the parents. In work they carried out in Pakistan, they recognized from the outset that although the mother is not the sole household decision maker, health workers tend to work only with females in the household. They tried to engage with all female caregivers, including during the home visits. She noted that is has been hard to delineate the effect, but they do have qualitative data about what the grandmothers were taking on board.

Another participant mentioned the impact on siblings at different levels of development in the household, who can impact a child’s development by providing additional stimuli. Yousafzai said that using or targeting a sibling as someone who can support learning opportunities need to be addressed. In her work in Pakistan, 66% of mothers in the two-year trial had delivered another child during that period. Children play naturally, so being able to leverage and harness that is useful. In these types of interventions, she said, the age group being targeted is very important.

The main sustainable benefit comes from building a responsive relationship and secure attachment between a young child and a mature adult caregiver. Strengthening the relationships between parents and children should be the focus, but there are other elements of interventions that can be enhanced.

Yousafzai responded to a question about how younger mothers fared compared to older mothers, especially in group settings. She said that it has not been analyzed yet, but multiple dimensions could benefit from such analyses, including the number of children a woman has, her experience with other children, her openness to new ways of doing things, and her level of autonomy to make decisions about her child’s wellbeing and her own health. Asked about how the accessibility of recreational and health care facilities may impact a child’s development, she noted that much-needed work is looking into how young children experience their physical environments in terms of child safety, child friendliness, and community-level responsiveness to young children. The benefits of increasing opportunities for physical activity through all of childhood are well established, she said. Enhanced physical activity contributes to improved executive function, problem-solving ability, working memory, and self-regulation.

2.4 MENTAL HEALTH AND CHILD DEVELOPMENT WORKING GROUP PROPOSALS

Aisha Yousafzai reported back from the working group on mental health and child development. They recognized that many of the basic health services provided in these countries are health interventions, with occasional nutrition interventions and less frequent interventions to monitor and promote growth. There is a clear gap in interventions aimed at parenting and promoting the development of children, she said, and a framework to comprehensively support young children and families requires an enabling environment for women in addition to child-specific services.
The group proposed creating an ambitious set of interventions, with one arm that taps into and integrates with opportunities that already exist in the current health platform to strengthen child development. The intervention in this arm would begin at pregnancy and continue through the first 1000 days of the child’s life. The second arm would comprise an enriched, community-based, cross-sectoral body of interventions to promote mental health and resilience in households through a two-generational approach. Interventions in this arm would promote the thriving of young children as well as mental health, resilience, and economic empowerment of families and particularly the female caregiver. Outcomes would target the potential benefit of the two-generational approach in strengthening the enabling environment for the child and the families. These outcomes would be measured across a set of indictors related to empowerment, mental health, and thriving. She said that next steps would include costing the interventions, but also considering sustainability and additional ways to bolster independence of households.

During the discussion, Yousafzai addressed questions about the interventions’ locations, targets, unit of intervention, and unit of randomization. The group considered implementing the intervention in settings in Asia and Africa. She said that the multi-sector intervention would be community-based and integrated into the health system. Because it is a two-generational approach, the intervention would be household-focused and target the needs of women that are not directly related to their children. For example, empowerment interventions might include microfinancing or vocational training to generate income that could then be invested in the wellbeing of the entire household. In the basic arm, the intervention would focus on enriching services for women and children by targeting a more traditional set of outcomes that are more child-focused.
3 Adolescent sexual and reproductive health interventions

3.1 INTERVENTIONS TO IMPROVE ADOLESCENT SEXUAL AND REPRODUCTIVE HEALTH

In her presentation, Jocelyn Finlay, Harvard T.H. Chan School of Public Health (U.S.), sought to open up the dialogue about interventions to prevent child marriage in the ARISE network. She noted that many issues in the child marriage domain can overflow into other issues in adolescent sexual and reproductive health (ASRH). Work in ASRH tends to focus on a set of common outcomes including menstrual health, sexually transmitted infections (including HIV), gender-based violence, female genital cutting, child marriage, and early childbearing. She suggested that child marriage would be a good topic to explore within the countries in the ARISE network.

Finlay presented Table 31 to provide context on ASRH in the ARISE sites. Early sexual initiation is common, as are high pregnancy rates, low condom use, and high self-reported sexually transmitted infections. However, she noted that sample sizes are very low compared to the total populations, reflecting how getting adolescents to respond to survey questions is a key challenge inherent in exploring ASRH. In Ethiopia, for example, they were only able to get 23 women to answer the question of whether they had ever been pregnant. The data in the table could be an underestimation of what is going on in the ARISE sites, she said. The data are also quite varied across sites, which may also be a result of the low response rates. Of the people that responded in Ethiopia, 26% of women aged 15 to 19 years said they had been pregnant. In Ghana, 48.8% said they had been pregnant and in Swaziland, 16.7%.
Table 2. Adolescent sexual and reproductive health in ARISE sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Sex</th>
<th>N</th>
<th>Ever been pregnant % (95% CI)</th>
<th>Condom use at last sex % (95% CI)</th>
<th>Other contraceptive use at last sex % (95% CI)</th>
<th>Age at first sex &lt; 15 years % (95% CI)</th>
<th>Self-reported STI % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kersa, Ethiopia</td>
<td>Male</td>
<td>20</td>
<td>5.0 (0.0, 25.4)</td>
<td>20.0 (7.5, 42.2)</td>
<td>30.0 (14.3, 52.1)</td>
<td>15.0 (4.4, 36.9)</td>
<td>0.0 (0.0, 0.0)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>19</td>
<td>15.8 (4.7, 38.4)</td>
<td>10.5 (1.7, 32.6)</td>
<td>15.8 (4.7, 38.0)</td>
<td>10.5 (1.7, 32.6)</td>
<td>0.0 (0.0, 0.0)</td>
</tr>
<tr>
<td>Ningo Prampram, Ghana</td>
<td>Male</td>
<td>39</td>
<td>12.8 (5.1, 27.1)</td>
<td>28.2 (16.4, 43.9)</td>
<td>18.0 (8.7, 33.0)</td>
<td>33.3 (20.6, 49.1)</td>
<td>3.2 (0.0, 17.6)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>43</td>
<td>48.8 (34.6, 63.3)</td>
<td>30.2 (18.5, 45.2)</td>
<td>16.3 (7.8, 30.3)</td>
<td>30.2 (18.5, 45.2)</td>
<td>7.7 (1.0, 25.3)</td>
</tr>
<tr>
<td>Ibadan, Nigeria</td>
<td>Male</td>
<td>57</td>
<td>7.3 (2.4, 17.8)</td>
<td>54.7 (41.5, 67.4)</td>
<td>13.0 (6.1, 24.8)</td>
<td>33.9 (22.9, 47.0)</td>
<td>16.1 (6.6, 33.1)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>33</td>
<td>30.3 (17.3, 47.5)</td>
<td>39.3 (23.5, 57.6)</td>
<td>27.6 (14.5, 45.9)</td>
<td>25.0 (13.0, 42.3)</td>
<td>0.0 (0.0, 0.0)</td>
</tr>
<tr>
<td>Lubombo / Manzini, Swaziland</td>
<td>Male</td>
<td>50</td>
<td>50.8 (38.8, 62.7)</td>
<td>19.1 (11.1, 30.6)</td>
<td>54.0 (41.8, 65.7)</td>
<td>66.7 (54.3, 77.1)</td>
<td>7.9 (3.1, 17.7)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>16</td>
<td>16.7 (7.5, 32.3)</td>
<td>18.9 (9.2, 34.5)</td>
<td>48.7 (33.5, 64.1)</td>
<td>51.4 (35.9, 66.6)</td>
<td>13.9 (5.6, 29.1)</td>
</tr>
<tr>
<td>Dar es Salaam, Tanzania</td>
<td>Male</td>
<td>84</td>
<td>9.9 (4.9, 18.5)</td>
<td>48.2 (37.8, 58.8)</td>
<td>19.1 (12.0, 28.8)</td>
<td>20.2 (12.9, 30.1)</td>
<td>1.6 (0.0, 9.4)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>91</td>
<td>27.4 (19.0, 37.8)</td>
<td>58.6 (48.1, 68.4)</td>
<td>17.2 (10.6, 26.6)</td>
<td>11.4 (6.1, 19.9)</td>
<td>1.3 (0.0, 7.8)</td>
</tr>
<tr>
<td>Dodoma, Tanzania</td>
<td>Male</td>
<td>93</td>
<td>7.5 (3.5, 15.0)</td>
<td>37.6 (28.4, 47.8)</td>
<td>20.4 (13.4, 29.8)</td>
<td>45.2 (35.4, 55.3)</td>
<td>1.7 (0.0, 9.9)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>69</td>
<td>44.9 (33.8, 56.6)</td>
<td>39.1 (28.5, 50.9)</td>
<td>20.3 (12.3, 31.4)</td>
<td>24.6 (15.9, 36.1)</td>
<td>0.0 (0.0, 0.0)</td>
</tr>
<tr>
<td>Iganga / Mayuge, Uganda</td>
<td>Male</td>
<td>55</td>
<td>10.9 (4.7, 22.2)</td>
<td>57.4 (44.1, 69.7)</td>
<td>7.4 (2.4, 18.5)</td>
<td>29.9 (18.7, 42.2)</td>
<td>6.8 (1.7, 18.9)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>48</td>
<td>29.2 (18.2, 42.2)</td>
<td>67.4 (52.9, 79.2)</td>
<td>6.5 (1.6, 18.1)</td>
<td>10.4 (4.1, 22.6)</td>
<td>4.8 (0.5, 16.6)</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval; STI = sexually transmitted infection
Source: Finlay, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

3.1.1 Child marriage as an outcome of adolescent reproductive and sexual health

Finlay narrowed in on child marriage as an ASRH outcome. She explained that the social predictors of ASRH are wealth, education, urban versus rural setting, household composition, and whether or not the mother is alive. With respect to child marriage, this can lead to poor outcomes for girls, with early childbearing, increased risk of
obstetric complications, increased risk of poor child health outcomes, increased risk of intimate partner violence, and increased risk of lower education attainment, lower job quality, and overall lower women’s economic empowerment. Child marriages leaves girls vulnerable to early child bearing. Finlay noted that married girls are a particularly vulnerable group because they are “forgotten”: that is, they are isolated from their own parents, may have lower educational attainment that hinders their decision-making skills, and there might be a large age gap with their spouse. Girl brides tend to have low contraceptive use, unwanted pregnancy, and poor child health outcomes. Research also indicates that there is a higher frequency of intimate partner violence as result of child marriage. Child marriage also leads to poor life-course empowerment because there is no opportunity for these women to “catch up” as they grow older. Child marriage and early childbearing go both ways, she added: young brides are expected to have children soon after the wedding and young couples may marry in the event of pregnancy. Box 31 contains a summary of some of the structural drivers of child marriage.

Box 3. Structural drivers of child marriage

Finlay explained that a child bride is situated in a structural position of success or failure that may be largely contingent upon decisions made by her family on her behalf. In terms of individual characteristics, key factors include the girl’s birth order in relation to the boys in the family, which has been shown to impact the outcomes of girls. Family pressure, being in or out of school, community norms, and the legal age of marriage (at the institutional level) all contribute to her success or failure within that structural framework. In the case of child marriage, the girl is put into this position within which she lacks agency, decisions are made for her by her family, community, and at the institution (legal) level, and she is not in a position to make her own decisions.

The World Bank has identified a set of drivers of child marriage, said Finlay. Push factors derived from parents and societal norms include poverty, limited opportunities for educational attainment and vocational training, and low perceived value of girls in society. With respect to the latter point, she suggested, the perception might differ between different contexts. For example, in some contexts, girls might be expected to be principle income earners, but in others they are not. Pull factors originating from the girl may include attachment seeking and resilience building, especially in fragile settings. She reported on her own research that shows that in highly vulnerable humanitarian crisis settings, women may seek marriage out. Attachment creates a sense of resilience and young women who are not living with their mothers, for example, may seek out attachment through marriage based on their own preference. Although it may not lead to an optimal outcome, she added, it is something that comes from within the girl that allows her to build her own resilience.

Source: Finlay, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018
3.1.2 Interventions to prevent child marriage

Finlay provided an overview of some interventions that have been implemented to prevent child marriage. She noted that there have been rigorous evaluations of various interventions. Structural interventions include those targeting the legal and policy framework—such as adjusting the legal age of marriage and whether there is a dowry versus a bride price—as well as community, schooling, and economic approaches. Community approaches are aimed at shaping attitudes, behaviors, and social norms through social and behavioral change communication. This is different from behavioral economics, she noted, which is about nudging people in a direction instead of changing people's minds. In addition to schooling approaches focused on how education can build future aspirations, school can also be framed as a safe space to keep girls away from the pressures of the adult world. In some cases, they have added additional curricula on sexual and reproductive health offered during school. Economic approaches to prevent child marriage try to address poverty, which is a significant driver of child marriage. Evidence and short-term evaluations indicate that such interventions have had quite a bit of success, she said. These include vouchers in Columbia, subsidies in Kenya, and conditional and unconditional cash transfers in Malawi and Kenya.

Individual level approaches include the empowerment approach and behavioral economics. Interventions are often bundled with an empowerment approach to help enable girls to act and advocate for themselves through training, skill building, information, safe spaces, and support networks. She noted that there are not many behavioral economic interventions in the space of child marriage, but she suggested that they should be part of the dialogue and have the potential to offer innovative ways to improve the work of the ARISE network.

Given the pull factors that can be at play in child marriage (especially in the context of humanitarian crisis settings), she said, it is important not to construe girls as always completely lacking in agency with respect to child marriage. Structural interventions alone are not sufficient and such cases need to be addressed through behavioral economics interventions. This involves identifying biases and inconsistencies that distort decision making through strategies such as reminders, commitment devices, and identity priming.

Finlay observed that ASRH is always a difficult topic, because adolescents are still children who are in need of protection. Caregivers and parents have the important roles of upholding their adolescents’ rights and enabling their empowerment such that they can become agents of their own when they are 18. Adolescence is that journey toward that goal, she added, which is very different than the element of child protection at play when considering a small child. As a result, adolescents are a difficult age group to target in interventions. Preventing child marriage puts pressure on parents and communities to fulfill their responsibility to both protect and enable their adolescents to grow towards independence and empowerment.

3.1.3 Lessons from past interventions to prevent child marriage

Finlay surveyed some lessons learned from past interventions aimed at preventing child marriage, some of which have had unintended consequences and negative outcomes post-intervention. For example, a study on an intervention in Malawi found that conditional versus unconditional cash transfers were able to keep girls in school and increase the age of marriage. After the intervention ended, however, the treatment group had moved against social norms; they had missed out on the marriage market and were trying to catch up. Then they reentered the marriage market after the intervention ended, they ended up getting partners who were not as high quality.
in terms of wealth or income potential. Also, they engaged in risky sexual behavior to try to catch up. At long-term follow up, the same study found that delaying marriage does not guarantee that the gained time is used as expected to generate physical, human, or social capital. Another study found that older brides were faced with a higher dowry price.\textsuperscript{29} Other studies have found the interventions’ impacts to be insignificant. For example, programs can impact school enrolment and early childbearing, but not child marriage.\textsuperscript{30} Most programs bundle empowerment with other programs, she said, which suggests that involving parents and communities appears to be critical.

### 3.1.4 Developing proposals for interventions

Finlay suggested a set of considerations for developing a proposal for an intervention to address child marriage. For example, an ongoing program could be evaluated and adapted for a new setting, or an entirely innovative program could be implemented. In terms of country selection, options to consider include working in a country with an existing large problem with child marriage, a country that is on the margin and thus has a higher chance of success, or a country that is willing and able to implement the program. Selecting the program type requires decisions about empowerment, community, schooling, and/or economic approaches to be implemented.

### 3.1.5 Policy levers

Finlay concluded by describing some of her own work on policy levers in the family planning space. Averting adolescent childbearing may involve targeting the proximate determinants of fertility (e.g., age of marriage, contraceptive use, abortion, and breastfeeding/abstinence) as well as the social determinants of fertility, such as wealth and education. For example, she has looked at the effect of introducing contraception on the total fertility rate and how it compares to impact of delayed age of marriage on the total fertility rate. Thus, from a policy perspective, we can observe how contraceptive use compared to delayed marriage has impacted the total fertility rate. Figure 6 depicts the relative representation of policy levers in Ethiopia over time. The gaps represent changes across time, with the gap between the blue and the red representing the contribution of the age of exposure to the total fertility rate. The next gap between the red and the green represents the impact of contraception use in reducing the total fertility rate. The gap between the blue and red is different across the wealth percentiles in Ethiopia, but it is relatively constant, which means that the contribution to early childbearing has not changed much across time. It is different across the wealth percentiles, but relatively stable. In contrast, the contraceptive use gap has been widening, meaning that contraceptive use has been changing and increasing for these different wealth quintile groups. Thus, in the case of Ethiopia, policies that promote contraceptive use would be working with an existing trend of increasing contraceptive use, and the policy to promote would be an acceleration. In contrast, trying to prevent child marriage by changing the age of exposure requires pushing against the tide, she said, as the age of exposure and marriage has changed little over time. This comparison of the policies—increasing contraceptive use or preventing child marriage—highlights that preventing child marriage is not the low hanging fruit and it will take some effort to see child marriage eliminated.

\textsuperscript{29} Kalamar et al J Adolesc Health
\textsuperscript{30} Handa et al PloS one 2014
### 3.1.6 Discussion

Fawzi highlighted the distinction between delayed marriage and delayed childbearing, suggesting that it may be very difficult to expect women to delay childbearing once they are married due to cultural expectations in these settings. She agreed that contraceptive use seems to be very low for new brides and that married adolescents do not appear interested in delaying pregnancy, despite their young age. Abubakar Manu, University of Ghana School of Public Health, noted that adolescent girls do not generally have negotiating power with much older husbands about contraceptive use.

Participants discussed the frequency with which adolescent girls tend to marry much older men or adolescent boys close to their own age. It varies widely. It was noted that the large age gap seems to be less of a concern in Ethiopia and India as it is in other settings. Rai suggested that if child marriages cannot be stopped, then interventions should begin when an adolescent is married to encourage delayed childbearing and further education, for example. Finlay remarked that post-marital interventions are very difficult due to social norms about childbearing once married and about the incompatibility of being married and still in school. She said that this group is both highly vulnerable and the most difficult to target, so the best strategy is to work on preventing these early marriages and keeping adolescent girls in school for as long as possible.

Nega Assefa of Haramaya University, Ethiopia, asked if terms like child marriage, early marriage, and teenage marriage are interchangeable. Finlay replied that there is a wide spectrum ranging from 10-year-old...
girls being married off to 19-year-olds being married, so they should not be used interchangeably. She suggested that “teenage marriage” should refer to older teenagers.

David Guwatudde of Makerere University School of Public Health (Uganda) noted that in his country of Uganda, these types of marriages are a common practice among some of the population. He suggested that interventions should target this as a cultural practice that needs to be eliminated in a society’s cultural foundation, because the girls themselves (and often their parents) will not have the autonomy or control over their own lives to prevent early marriage until that fundamental change is made. He noted that even when there are laws against these types of marriages, they often go unenforced due to community pressure. Keshavjee added that even in countries with social norms and legal structures that ostensibly counter these types of marriages, they are still taking place in large numbers. For example, the U.S. has had 200,000 marriages of children under the age of 16 in the last 15 years, including 1000 people under the age of 14. Because they are under the threshold for the statutory rape age in many states, marriage permissions were granted by judges. He suggested that in certain states like Louisiana, Alaska, and South Carolina, these marriages may be driven by cultural values in conjunction with poverty and other factors.

Preet Dhillon of India’s Public Health Foundation described a household approach that has been used to tackle multiple types of diseases and risk factors across the life course. She noted that common risk factors and comorbidities often exist among multiple people in the same household. The household approach involves reaching people in a household who have decision-making power regarding the household diet-- for example, targeting the mother-in-law of a woman who accesses reproductive health care and vaccines. It does not make sense to target individuals who are not empowered to make decisions, she said. The household approach ties into broader cultural and gender-related issues in various settings, she added, noting a study which found that the strongest determining factor for accessing cervical/breast cancer testing in India other than level of education is whether the woman has a bank account.

Rai asked Finlay about that level at which interventions should be focused. She emphasized that interventions need to be multi-level due to these types of cultural and household factors, in which parents are often the decision makers. Adverse long-term outcomes from the unconditional cash transfers in Malawi were a direct result of intervening with the treatment group to delay marriage in a way that was not aligned with parallel changes in societal norms, she said. Operating outside the social norms puts those adolescents at a disadvantage.

### 3.2 Creating Demand for Youth-Friendly Sexual and Reproductive Health Interventions

Abubakar Manu, University of Ghana School of Public Health described a research proposal designed to create demand for youth-friendly health services in Ghana. He provided an overview of the demographic profile of adolescents in the country. The adolescent population increased fourfold between 1960 and 2010 and currently, adolescents account for 22.4% of the population of Ghana. The proportion of adolescents is projected to increase over the next 20 years.

#### 3.2.1 Risky sexual behaviors among adolescents in Ghana

The increasing adolescent population lacks information about sexual and reproductive health and how to manage their lives during the transition from childhood to adulthood, said Manu. This lack of information manifests in their risky sexual behaviors. Table 3 provides data on the percentages of males and females aged between 15 and 24 years who have engaged in risky sexual behaviors as well as their knowledge of HIV/AIDS. Manu noted
that 33.7% of females between 15-19 years of age have had sex with non-marital and non-cohabiting partners and that approximately 9% of both males and females between 15-19 years have had sex for cash, gifts, or favors. There is a large disparity in the percentages who reported having had sex with multiple sexual partners in the previous year: ranging between 7%-8% of females and between 30%-37% for males. Similarly, 3% of females between 15-19 years old reported having had multiple non-marital partners in the last 12 months, which was reported by 23% percent of males of the same age group. In addition to demonstrating that adolescents are engaging in risky sexual behaviors, the data also show that many do not have comprehensive information about HIV/AIDS, and among those who do, many do not act upon it. Between 18%-22% of young women and between 25%-31% of young men have comprehensive knowledge of HIV/AIDS, but only 6.6% of young males aged 15-19 years have ever been tested. In contrast, around 25.7% of females in the same age group had been tested at least once.

Table 3. Risky sexual behaviors and knowledge of HIV/AIDS among adolescents in Ghana
<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever had sex with non-marital partners (%)</td>
<td>33.7</td>
<td>21.8</td>
</tr>
<tr>
<td>Sex in exchange for cash or favor (%)</td>
<td>8.9</td>
<td>7.5</td>
</tr>
<tr>
<td>Sex with multiple sexual partners in last 12 months (%)</td>
<td>6.9</td>
<td>8.0</td>
</tr>
<tr>
<td>Multiple non-marital partners in last 12 months (%)</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Sex with boyfriend or girlfriend (%)</td>
<td>11.7</td>
<td>23.6</td>
</tr>
<tr>
<td>Know a place to get tested for HIV/AIDS (%)</td>
<td>60.1</td>
<td>81.8</td>
</tr>
<tr>
<td>Ever been tested for HIV/AIDS (%)</td>
<td>25.7</td>
<td>52.0</td>
</tr>
<tr>
<td>Comprehensive knowledge of HIV/AIDS (%)</td>
<td>18.1</td>
<td>21.8</td>
</tr>
</tbody>
</table>

Note: y = years
Source: Manu, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

3.2.2 Teenage pregnancy and child marriage in Ghana

A consequence of this lack of information among adolescents in Ghana is a high rate of teenage pregnancy. According to the 2014 Ghana Demographic and Health Survey, the nationwide prevalence of teenage pregnancy is 14.2%. Among Ghana’s ten regions, those with the highest regional rates of teenage pregnancy are Brong Ahafo region (21.3%), Central region, (21.3%), and Volta region (22.1%) which are all over 20%. Manu reported that their study will be conducted in the Central region because while the Brong Ahafo and the Volta regions have various on-going sexual and reproductive health interventions, the same cannot be said of the Central region.

Child marriage

Today, nearly one-third of young girls in Ghana are married off while they are still children. Manu noted that even when children have support from their parents, they can find ways to navigate around them. He related the story of a 15-year-old girl whose mother had died so she was staying with her aunt. Her family was trying to marry her to an older person against her wishes. Manu reached out to services who were able to intervene on her behalf. He noted that child marriages have been decreasing in Ghana since 1988. However, as of 2014, 27.2%
of women aged 20-49 had married by the age of 18 and 7% had married by the age of 15.

3.2.3 Nutritional status of adolescents in Ghana

Manu provided an overview of the nutritional status of adolescents in Ghana (see Figure 7). According to the 2014 Ghana Demographic and Health Survey, 14.4% of adolescents were undernourished (BMI <18 kg/m²) in 2014, far exceeding the rate in any other age group. Among women, there is also a high prevalence of anemia, particularly among those aged 15-19 years. A participant asked about the large increase (10%) in adolescent undernutrition between 2008 and 2014. It was noted that a separate scale is typically used for adolescents aged 15-19 years, with much lower cutoffs. The BMI cut off of <18.5 is a little high, and should probably be set at <16 for the adolescent period. He suggested that this chart is an overestimate of the actual undernutrition among that age group. Another participant noted that a recent review looked at dietary data for adolescents, indicating that those aged 15-19 years are consuming fewer calories than those aged 10-14 years. This suggests intentional calorie restriction. Manu agreed that anecdotally, he has heard from adolescents that they are restricting their diets to stay thin.
Figure 7. Prevalence of undernutrition and anemia among adolescents in Ghana

Source: Manu, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

3.2.4 Policy framework

Manu said that Ghana has adolescent-friendly policies that support adolescent development, but there are problems with implementation. He enumerated a number of key policies that have been enacted or are in the process of being implemented in Ghana.

- Adolescent Sexual and Reproductive Health Policy, 2000 (revised, awaiting approval by Cabinet)
- National Reproductive Health Policy and Standards, 2016
- ASRH Communication Strategy (2016-2020)
- Gender in Education Policy (ongoing)
- Guidelines to Reduce Teenage Pregnancy and to Facilitate the Re-entry of Teenage Mothers into the Ghanaian Education System (ongoing)
- National Adolescent Health Service Policy and Strategy (2016-2020)

He noted that these efforts have been somewhat undermined by problems including lack of intersectoral collaboration. But the major problem, said Manu, is that adolescents are not accessing the services available to improve their health. As part of an effort to improve access to information toward improving adolescent health, Ghana has adopted and implemented the adolescent-friendly corner initiative as the main intervention nationally for the past twenty years. The “adolescent-friendly corner” is a corner where young people can walk in to access information and services. However, it has not been effective enough.

Evidence shows that many adolescents in Ghana find it difficult to access sexual and reproductive health services. A study on utilization of youth-friendly health services in the Tema metropolis found that only 12.3% of adolescents visited youth-friendly centers. The study identified a set of barriers that contribute to poor access to services among adolescents. The first is lack of awareness that the service points even exist. Other barriers include embarrassment, lack of privacy, and lack of confidentiality. For example, someone who goes to church with a child’s mother

32 Aninanya et al PloS one 2015
33 Odoi 2017
may reveal that her child came to the youth-friendly corner to ask for contraception. Cultural stereotypes and stigmatization are additional factors, he said, that discourage young people from going to the centers for fear that people will make assumptions about their sexual activity.

3.2.5 Proposed intervention to create demand for youth-friendly service

Manu described the intervention that has been proposed in Ghana to create demand for utilization of youth-friendly services through comprehensive ASRH education, information, and communication. The aim is to demonstrate that a well-structured ASRH promotion and education intervention can improve adolescent-friendly health service utilization and ultimately improve adolescent health outcomes. He noted that information is already circulated in and out of schools, but the intervention will seek to facilitate the harmonization that is currently lacking. The planned study design is quasi-experimental, with a nonequivalent comparison group. The study area is Central region, and the study will focus on two randomly selected districts, one intervention and one control. In the intervention district, the intervention will provide full support in terms of information, education, and training.

He explained that the study’s conceptual basis is guided by the three constructs underpinning the Andersen and Newman’s Behavioral Model of Health Service Utilization: predisposing factors, enabling factors and need factors. The three constructs inform the study’s three phases. Phase 1 focuses on predisposing factors and seeks to influence individual and interpersonal level antecedents of adolescent decision-making and risk taking. Phase 2 focuses on enabling factors to improve the social environment of the adolescents, so they are comfortable accessing services. The plan is to work through schools and school clubs as well as improving parents’ skills in discussing reproductive health with adolescents to mitigate its stigma. He noted that most parents in Ghana lack the capacity to discuss reproductive health, even with their own children. He added that it is difficult to even refer directly to the penis and vagina in the local language; they are always described with different expressions and euphemisms. Phase 3 works on need factors to increase access to utilization of youth-friendly health services.

The intervention will consist of evidence-based and theory-driven targeted ASRH promotion and communication. For sustainability, the intervention will be implemented through existing structures of the Ghana Health Service and the Ghana Education Service - School Health Education Program (SHEP). He said that SHEP has been in place since 1992 and represents a successful collaboration between Ghana Health Services and Ghana Education Services. The plan is to train frontline health service providers managing the youth-friendly corners to be receptive to young people. They will equip adolescents with up-to-date, comprehensive information about sexual and reproductive health through school programs and clubs. They will also encourage providers to use the GHS-FHM application to access information remotely via smartphone.

The intervention has three modes of delivery: in-school adolescents, out-of-school adolescents, and parents. Adolescents still in school will be reached through in-school adolescent health clubs. Trained club mentors will include health providers, nongovernmental organization staff, and representatives from other institutions working in adolescent health. School-based health coordinators will include the already existing SHEP coordinators as well as guidance and counseling coordinators. Selected club members will be trained as health ambassadors who are responsible for organizing seminars, health talks, and generally promoting the club. He reported that a number of schools are already onboard and setting up clubs. Out-of-school adolescents are difficult to reach, but they are planning to use mobile technology and applications to

34 Andersen et al Milbank Mem Fund Q Health Soc 1973
provide basic information about sexual and reproductive health, pregnancy prevention and so forth. They are considering using SMS and interactive voice response to re-enforce the message they read on the app. They are also planning peer-to-peer household visits in communities to share information about sexual and reproductive health. To work with parents to create demand for adolescent and youth-friendly health services, the plan is to create parent support groups for monthly meetings. This will allow the identification and training of some parents as community-based champions who will organize parent-support meetings. Each community in Ghana has community information centers, where information from the meetings can be disseminated. They will also identify and sensitize organized groups, such as religious groups.

3.2.6 Discussion

Finlay commented on the peer-to-peer mobile application that Manu described. That approach has been shown to work for the peer leader, but not for those to whom they are disseminating their knowledge and attitudes. She also remarked upon his comments about the risk of gender-based violence. People push back by saying, ‘we don’t want to get men involved,’ because that essentially reinforces the biases that need to be broken down. She warned that it is important to involve parents, but it is important not to reinforce the biases that they may have about their adolescent children’s health. There must be a movement against these existing biases, she added, rather than promulgating them.

Another participant noted the problem of adolescents being asked about sexual matters by people from their own community. Manu agreed that sexual issues are very sensitive and a subject many are reluctant to talk about, leading to underestimations of sexual behavior. To address this, they use people from a different community to obtain the information confidentially. Justine Bukenya of the Makerere University School of Public Health (Uganda) asked about the sustainability of youth-friendly centers. In Uganda, they established a similar network of youth-friendly centers across the country; although they worked in some settings, in others they actually served as a deterrent to accessing health services and parents were not happy with what was being offered. She suggested that rather than having these dedicated corners, health workers in all facilities should be trained in how to accommodate youths appropriately and without stigma or discrimination. Extended service hours might be helpful because adolescents are often in school until the evening. Manu agreed that health centers should offer extended service in evenings and weekends to receive young people. Location is another challenge, said Manu, as sometimes these adolescent-friendly centers are set up where many people can see who is coming and going. He described a case where an adolescent-friendly corner was sited adjacent to an HIV clinic, leading to assumptions about a person’s HIV status if adolescents were seen going to the adolescent corner. More effort should be made to place these services in more discreet locations, he said.

3.3 SEXUAL AND REPRODUCTIVE HEALTH WORKING GROUP PROPOSALS

Jocelyn Finlay reported out from the working group on sexual and reproductive health. They focused on assessing next steps and applying lessons learned, such as the adverse outcomes of the conditional cash transfers that incentivize behavior that is contra to social norms. They discussed how many girls marry young because there are not many viable alternatives for them otherwise. She noted that this is a recurring theme in work on women’s economic empowerment: there must be viable alternatives available in the social milieu. While it is desirable to keep girls in school, the issue is the options that are available to them when they finish school.

In that vein, the group discussed setting up girls’ clubs to help strengthen life skills. A program being evaluated in Ethiopia
has shown such clubs to be beneficial in keeping girls in school and delaying the age of marriage. They also discussed ways to build the income potential for girls by setting up school-based farms. However, that may not garner uptake because it is too agriculturally focused and might not be perceived as modern enough. They also considered embedding vocational training in the school curriculum through an eight-year program for girls aged 10-18 years. This long-term vocational training might include computer programming, hairdressing, carpentry, marketing, and accounting skills to supplement school curriculum. Ideally, it would not deter those who aspire to go onto university, but rather it would create a sense that there are alternatives to marriage and there are benefits to staying in school until matriculation. This vocational training could be implemented through coordination with the educational systems in Ghana, Uganda, and Ethiopia. The intervention would provide schools with a starting kit with the tools needed to teach any of the vocational skills. She noted that in Ghana, they have carpentry programs, but no tools with which to teach them. At the end of matriculation, girls would be provided with a starter kit to apply the skills they learned—for example, providing money to set up a salon for girls who learned hairdressing. This intervention would aim to create an alternative life course for girls, as well as increase their sense of self-worth and their value in society.

One of the issues with child marriage is that girls are not highly valued, Finlay explained. If they delay entering the marriage market, then they end up doing poorly in it. Increasing their expected life-course income could make girls more desirable on the marriage market while still providing them with productive life skills. Ideally, this training would also be beneficial to a girl’s current family and their parents would encourage them to finish it. The intervention’s intended outcomes would be that the girls stay in school, build an alternative life-course trajectory, and delay the age of marriage. Secondary outcomes would be to increase the girls’ self-worth and empowerment while also improving the girls’ perceived value from the perspective of parents and potential husbands.

During the discussion, Finlay noted that evaluating the intervention via comparison would be difficult, especially because the three countries have national curriculums in their schools. Evaluation would require adding the vocational training as an extra component in some areas but not in others. Because it is a long-term intervention, she added, retention of girls in school could be an ongoing evaluation. The group recommends a program that is longer than typical apprenticeship training, in order to discourage girls from being trained too quickly and then leaving school to ply their crafts full time. The length of the intervention would be a retention mechanism that keeps the girls in education for as long as possible. Participants discussed how the appropriate starting point and duration of the intervention might vary across countries. For example, in countries with a separate high school system starting in 9th grade—before which many students drop out of the system—the intervention should be started in 8th grade to try to capture students before they are lost, with a five-year program that carries on until the end of high school. National testing held at different points in countries’ educational systems may also complicate the intervention starting point and duration, said Finlay, so it might be simpler to begin the program in a single country.

Participants also discussed whether the program would be offered to all girls in a school, as well as how many types of vocational training would be feasible to implement in a single school with respect to cost and logistics of setting up multiple separate programs. Finlay added that providing only a single type of training to all girls in a community’s school would create an oversupply in the market of hairdressers, for example, and might disincentivize potential mentors from working with the program. However, participants agreed that the
principle underlying the program extends beyond the specific vocational skill to building self-confidence, self-esteem, independence, and autonomy that may empower girls to continue their training in other areas over the years. They also discussed the potential to measure soft skills such as self-advocacy in the shorter term because the long-term impact will take much longer to assess, but promising interim process indicators would be helpful in making the case for implementing the intervention in other settings.
4 Urban food systems and food production interventions

4.1 IMPACT OF URBAN FOOD SYSTEMS ON HEALTH AND NUTRITION

Preet Dhillon of the Public Health Foundation of India focused on urban food systems in her presentation. She noted that proposals focusing on fruits and vegetables need to take into account a broad set of domains within food systems, which is dependent on the context of the low- or middle-income country (LMIC) in which the proposal is planned to be implemented. Fruit and vegetable intake is associated with nutrition status and chronic diseases, but rates of intake are generally low. Trends suggest that vegetable intake seems to be decreasing in some regions of the world while fruit intake is increasing, at least in absolute terms. Dhillon explained that the accessibility of fruits and vegetables in urban environments tends to be more constrained than in rural areas. The reasons for this are complex and vary according to factors, such as source and price, that are influenced by socioeconomic status. In urban areas in LMICs, there is a wide variation in economic status that greatly influences access.

The most effective approach to increase fruit and vegetable intake is not yet clear, Dhillon said, even though dietary risks are one of the major contributors to the global burden of disease. In addition to low fruit and vegetable intake, these dietary risks include high sodium intake, low fiber intake, low calcium intake, and high intake of processed meat. Estimations about the global burdens of disease indicate that fruit and vegetable intake is associated with ischemic heart disease, ischemic stroke, diabetes, and some cancers; she noted many cancers are more common to LMICs than in higher income countries. The top three risks are high sodium intake, low fruit intake, and low vegetable intake. This underscores the importance of focusing interventions on fruit and vegetable intake. Some ongoing debate is centered on the contention that many dietary policies focused on sugar, salt, and fat may not be aligned with the evidence, said Dhillon. She recommended that policies should focus on fruit and vegetable intake as well as other risk factors such as whole grains, nuts and seeds, and omega 3 fatty acids.

4.1.1 Urbanization and the obesogenic environment

Dhillon suggested that increasing rates of urbanization provide opportunities to learn from existing issues related to urbanization to better inform, develop, and understand food systems in urban areas. Globalization and the nutrition transition are key components of the overall picture. In India, for example, the industrialization of food production and the supply chain are becoming more sophisticated; residents of New Delhi have access to produce from all over the world while residents of other areas may have very limited access.

Globalization and the nutrition transition are creating an increasingly “obesogenic” environment, she said. Contributing factors include mergers and acquisitions resulting in smaller concentrations of food manufacturers who have greater influence. The past decade has seen “super” markets emerge in India, for example. Price differentials for energy-dense foods are also contributing factors in India, with marketing targeted towards adolescents and children. People in India refer to the “Western diet” as consumption of large amounts of animal proteins, fat, sugar, and salt. Cultural perceptions about being thin in communities that are battling malnutrition and other diseases that can affect body stature are another set of complicating factors.
at play in many LMICs including India, she said. For example, a study in Africa asked people about their beliefs about body image; their responses indicated that thinness was usually associated with sickness—specifically AIDS. Pervasive cultural perceptions that people who are large are healthy will be challenging to overcome and address, she added. She discouraged the use of the misnomer “overnutrition,” because it implies that a person is over-nourished. It actually refers to the second component of the dual burden of poor nutrition in many LMICs.

### 4.1.2 Pesticides in food systems

In the context of SDG 2, Dhillon highlighted the importance of considering the environment and its impact on foods—including fruits and vegetables—in addition to promoting food security and health. There are particular concerns from the agricultural perspective about how foods may be contaminated and from the environmental perspective about the quality of foods being produced. Yale University regularly releases an environmental performance index ranking countries based on 24 indicators within ten categories and she noted that India ranks near the bottom, ranking higher only than the Democratic Republic of Congo, Burundi, and Bangladesh.

Pesticides used for crop protection, food preservation, and disease control are a critical consideration when thinking about food systems in LMICs, said Dhillon. Pesticides are chemicals designed to kill, reduce, and repel pests. They form a large, heterogenous group—including insecticides, herbicides, fungicides, and rodenticides—that can have mutagenic, carcinogenic, and immunotoxic properties. Dichlorodiphenyltrichloroethylene (DDT) is still used in India to control malaria and other mosquito-borne diseases even though it has been banned in many countries across the world for decades. Pesticides were not used in India until the 1940s, but there are now thousands of formulations on the market in the country. Pesticides are linked to a range of different acute and chronic health effects depending upon the route of exposure (through the lungs or eyes, for example). In terms of adolescent health and ECD, children are at great risk from pesticide exposure. This can begin with germinal cell damage in fathers and it can influence in utero development and birth outcomes. Because children tend to have higher respiratory and metabolic rates than adults, their risk of exposure to pesticides is also greater. Evidence from air pollution studies shows that children have a higher level of exposure just by being closer to the ground, where the concentrations are higher.

Although it is up to the discretion of individual countries to choose how to control pesticides and other toxic pollutants, Dhillon said, most countries in the world have come together in an alliance under the Stockholm Convention to eliminate or limit the exposure to persistent organic pollutants (POP). POPs are carbon-based substances that contain a combination of physical and chemical properties that are toxic to both humans and wildlife. POPs remain intact for many years and become widely distributed in the environment through natural mechanisms in soil, water, and air as well as accumulating in the fatty tissue of living organisms. Initially, 12 POPs were recognized but the list was recently expanded to include 16 additional chemicals. To date, more than 150 countries have signed on, but the U.S. has not. Dhillon suggested that the POP convention provides an opportunity to work on measuring and monitoring the progress in terms of eliminating exposure to these chemicals in different food systems. She noted that exposure levels can vary widely among and within countries. In India,

---

36 Air quality, water and sanitation, heavy metals, biodiversity and habitat, forests, fisheries, climate and energy, air pollution, water resources, and agriculture.
37 Greenop et al Cancer Causes & Control 2015
39 The initial list included pesticides (aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, and toxaphene), industrial chemicals (hexachlorobenzene, and polychlorinated biphenyls) and by-products (hexachlorobenzene, polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, and PCBs).
for example, there are high but variable exposure levels to DDT, which has been found in samples from many types of biological specimens: environmental samples, food samples, dairy milk, breast milk, and adipose tissue.40

4.1.3 Research background and proposals

Dhillon said that research proposals should be developed to inform policy by better understanding food systems and the impact of fruit and vegetable intake and access. Proposals should focus on the double burden of malnutrition and chronic diseases associated with fruit and vegetable intake. In-depth mixed methods analyses could provide a suite of mixed methods tools that could then be used in other urban food systems in LMIC settings, she added. For context, she outlined some of the research that has already been done. She noted that much of the work has been carried out in high-income countries—albeit sometimes in low-income communities within those countries—and has been focused on the consumer perspective to elucidate the drivers of food choice and consumption. She noted that much work done in LMICs has focused on the agricultural perspective and suggested approaches directed toward understanding consumers’ perspectives are both timely and needed for LMIC settings. She surveyed a sample of existing work that has looked at fruit and vegetable intake in a range of settings (see Box 4).
Box 4. Studies on fruit and vegetable intake, consumer perspectives, and health outcomes

To provide context for future research proposals, Dhillon described a sample of studies that have looked at consumer perspectives and the association of fruit and vegetable intake with health outcomes in various settings.

- A house-to-house survey study in Philadelphia (U.S) interviewed participants about fruit and vegetable purchasing and consumption patterns. They found that less than half of the sample (which comprised more than 80% African American households) would go to local markets to buy their fruit and vegetables.

- The CARRS surveillance study is a cohort-modeled, community-based surveillance plan for capturing cardio-metabolic diseases that is also working to understand fruit and vegetable consumption patterns. They found that affordability and awareness—as opposed to accessibility—were the major barriers. Additionally, one-quarter of the sample, which represents people across the socioeconomic spectrum, reported that they would be willing to pay more for pesticide-free products. Dhillon described this finding as somewhat surprising.

- A prospective cohort study on the association of fruit, vegetable, and legume intake with cardiovascular outcomes among urban and rural populations in 18 countries (the PURE study) found that affordability was a major issue. The cost of two servings of fruit and three servings of vegetables per day accounted for a little over half of the household income for participants from the low-income countries.

- A study from Fiji among indigenous and South Asian populations found that there was an increased preference for processed and imported foods. Dhillon remarked that the inconsistent availability and instability of domestic food supplies will need to be addressed and integrated into research proposals about urban food systems.

- A study in India tried to model the best type of diet to maximize years of life by 2050, finding that intake of meat, dairy, wheat, and rice should decrease, while the intake of fruits, vegetables, and legumes should increase.

Source: Dhillon, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

4.1.4 Ongoing work in India

Dhillon described some work ongoing by the Public Health Foundation of India and the CARRS surveillance study. A longitudinal cohort study that began in 2010 has been carrying out repeated biological sampling in a study population of more than 12,000 adults in Chennai and Delhi. They are currently in the fifth follow-up stage of a multistage cluster-randomized sample study stratified by gender. Another cross-sectional survey has expanded the sample size to a total of 20,000 adults in both of those populations.
This has enabled a large amount of data collection including demographic and social characteristics, anthropologic measurements, as well as behavioral risk factors related to cardiovascular, metabolic, mental health, and cancer outcomes. There is also work being done on the association between POPs and diabetes, said Dhillon. Preliminary results indicate that DDT was detected in 74% of participants, with the 95th percentile in the sample from Delhi found to be 257 ng/g lipid. For reference, the 95th percentile in the U.S. adult population is 20.7 ng/g lipid according to 2003-2004 data from National Health and Nutrition Examination Survey. β-HCH was detected in 91% of participants in the Indian sample, a value that is 27 times that reported for the U.S. adult population. A multi-center, hospital-based case-control study looking at pesticides and breast cancer in northern India found organic phosphates in more than 20% of biological specimens from participants, she reported.

Although consumers are concerned about pesticides, said Dhillon, it appears that people in India have come to accept the fact that adulteration exists, and food is not as clean as it used to be. One study cited the following quotes from participants surveyed:

- “They are full of chemicals. It is so poisonous, that we will get other diseases...” (Male, 62 years)
- “When you consider the price you have to pay for the chemicals in fruits, it is better not to eat it at all” (Female, 58 years)
- “Life is surrounded by adulterated things. We have to survive in the middle of these things” (Male, 57 years)

Dhillon concluded by describing opportunities to leverage existing studies in India on the built environment and GIS mapping. More than 10,000 households across India have already been geocoded and there is data on the built environment from more than 250 neighborhoods. She suggested that this could be used to examine different facts of the built environment and how they feed into food systems (e.g., accessibility of health care facilities, locations of food outlets, etc.). This could enable analysis of the nutrition transition with respect to the distances to unhealthy food outlets, which can be correlated with individual health outcomes in the individuals. For example, the nutrition transition in urban Delhi is characterized by the large number of unhealthy Indian food outlets, rather than the Western food outlets. A study found that full service and fast food restaurant density was associated with poor dietary intake and restaurant density was positively associated with overweight/obesity, but largely explained by socioeconomic status.

Future research directions include better understanding of fruit and vegetable intake within urban food systems, said Dhillon. She suggested carrying out an in-depth mapping exercise and interviewing key stakeholders (consumers as well as sellers) to investigate access, sourcing, transport, pricing, waste disposal, availability, and behavior patterns. She also suggested using GIS to map how fruits and vegetables makes their way to consumers (and vice versa) as well as doing analysis around sampling to understand more about food waste and safety. There is much work to be done in developing a conceptual framework to address these various domains, she said.

4.1.5 Discussion

Canavan asked about community-level awareness of pesticide contamination in food and its negative health impacts. She visited an organic farmer in Tanzania who said that he has problems selling his produce because it looks too good, and people assume that he has used pesticides. Dhillon replied that India is very heterogeneous, so the level of awareness varies widely. In the state of Kerala, for example, the awareness levels around pesticides is very high and people realize that

---

41 Daivadanam et al BMC Public Health 2015
42 Patel et al BMC Public Health 2017
produce that looks better is more likely to have pesticides on them. As a result, there is a market to make food look worse. They have created certain chemicals, sold on the black market, to spray on pesticide-treated produce that attracts flies because they know that the average consumer think that it is fresh and organic. At the other extreme, there are areas where people have no awareness of pesticides and their health effects, she said. Large numbers of people lack access to organic produce and/or feel that it is not affordable.

Alexa Bellows of the Harvard T.H. Chan School of Public Health (U.S.) asked whether consumers who believe that the entire food system is polluted with pesticides would be better off avoiding fruit and vegetable consumption entirely. Dhillon said that it is virtually impossible to completely avoid pesticides, because the levels in animal products in India are generally the same or even higher than those found in fruits and vegetables. She noted that an environmental advocacy group has been effective in raising public awareness and garnering media attention about pesticide levels, but thus far that has not translated to widespread popular demand for organic produce.

A participant suggested that herbicides could be an option for farmers who do not want to weed, but Dhillon replied that herbicides are just as problematic, as are most of the insecticides being used in India. There is a lack of regulation, personal protection, and awareness of the right levels of usage. People tend to use them at levels above and beyond the recommended usage to maximize yield. Jaacks noted that although herbicide use is increasing in India, it still represents a relatively smaller proportion versus insecticide use compared to other countries. She added that there is generally less concern about herbicide use because they are not persistent in the environment; however, studies have linked them to cognitive outcomes.

A participant suggested focusing on strategies to maximize benefits and minimize risks for consumers, asking if there is any existing guidance or messaging about how to mitigate risks. Dhillon replied that the messaging needs to focus on correct occupational use and ensuring that people being exposed to high levels have the appropriate protective measures in place. People need to understand how pesticides are intended to be used and adhere to those guidelines rather than ignoring them. She highlighted the importance of greater regulation and following through on existing bans on some of the chemicals that are known to be extremely toxic and designated as such by the Stockholm conventions, but are still being used. Jaacks remarked that there are some chemicals that are generally thought to be safe; for example, as pyrethroids used in malaria nets do not have demonstrated ill effects. She suggested targeting POPs and organic pollutants because it can be difficult to enact a ban on pesticides in many settings. She also noted that there may be room for innovation through genetically modified organisms, some of which have been shown to lead to decreased synthetic pesticide application.

Canavan added that chemicals designed for industrial farm use are often used in the inappropriate contexts of home or school gardens where children are exposed. She called for better education, stopping the spread of misinformation to consumers, and offering alternatives to pesticide use in home gardens.

Ramadhani Abdallah Noor (AAPH, Tanzania; and HSPH, U.S.) cautioned that farmers do not have appropriate guidance about pesticide alternatives: “we keep telling them not to use pesticides, but there’s inconsistent guidance or messaging on what they should do instead.” Dhillon replied that the livelihood and survival of farmers is fundamentally the key issue. Farmers’ main concern is maximizing yield for sustaining their families and they are not interested in any alternative that does not provide a better yield. Some movements are trying to promote organic farming strategies to maximize yield, but they have not yet caught on in a meaningful way. Dhillon said she is working on a proposal to compare
the health outcomes in conventional versus organic households by digitally connecting with farmers. She suggested that these types of tools and resources offer a way to connect farmers with each other, so they can support each other in transitioning to organic farming practices.

4.2 SUSTAINABLE URBAN DIETS TO IMPROVE HEALTH

Chelsey Canavan, Harvard T.H. Chan School of Public Health (Boston, U.S) provided an overview of an ongoing study looking at urban diets in Addis Ababa, Ethiopia. She began by describing the double burden of malnutrition worldwide.43 In 2014, more than 1.9 billion adults (aged ≥18 years) around the world were overweight—including more than 600 million who were obese—while 462 million were underweight. In the same year, 42 million children under the age of five were overweight or obese and 156 million were affected by stunting (i.e., low height-for-age). The United Nation’s Sustainable Development Goal44 (SDG) 2 is to end hunger, achieve food security and improved nutrition, and to promote sustainable agriculture. The indicators that have been set for SDG 2 are presented in Box 5.

Box 5. Indicators for Sustainable Development Goal 2

Canavan presented the specific indicators that have been set for Sustainable Development Goal 2: “End hunger, achieve food security and improved nutrition and promote sustainable agriculture.”

**Indicator 2.1:** By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.

**Indicator 2.2:** By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.

**Indicator 2.3:** By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

**Indicator 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

*Source: Canavan, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018*

---

43 World Health Organization 2017a
Canavan noted that indicator 2.4 links malnutrition, the environment, and sustainable food systems. She highlighted dietary intake because it contributes to a large burden of disease in the world, including in Ethiopia. Six of the top 11 risk factors driving the global burden of disease are related to diet, including direct dietary risk, high blood pressure, malnutrition, unhealthy body mass index, high fasting plasma glucose, and high cholesterol. Furthermore, diets are changing around the world, including increases in fruits and some increase in whole grains, and large increases in processed meat, sugar-sweetened beverages, and sodium across most regions. These transitions in what people are eating in many places in the world are emerging in the context of urbanization, which is happening rapidly in Africa. For example, Addis is one of the fastest growing cities in the world, with a population of about 4 million that is urbanizing at a rate of about 5%. Urban dwellers currently make up 19.5% of Ethiopia’s population.

4.2.1 Food environments

Canavan explained that the concept of a “food environment” does not refer to the natural environment, but the context in which people are consuming food. Within the food environment, diet quality is determined by diversity, adequacy, and safety. Four agricultural and food system policies link with diet quality as a measure of good nutrition:

- Agricultural production includes production for its own consumption and sale (policy options include agriculture research policies, input subsidies, extension investment, and land and water access)
- Market and trade systems involve the exchange and movement of food (policy options include trade policy, infrastructure, investment, and agribusiness policy)
- Food transformation and consumer demand includes food processing, retail, and demand (policy options include labelling regulation, advertising regulation, and fortification policy)
- Consumer purchasing power includes income from farm and non-farm sources (policy options include work guarantee schemes, cash transfers, school feeding, and consumer subsidies)

She also presented a conceptual framework of the links between diet quality and food systems and how they influence what people consume in households (see Figure 8).
Figure 8. Conceptual framework for the links between diet quality and food systems

Source: Canavan, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

4.2.2 Food systems and environmental impacts

Food systems have huge environmental impacts, Canavan said. Figure 9 illustrates the average energy use, blue water footprint, and greenhouse gas emissions per calorie of food for each food group. She noted that fruit and fruit juice are very high in energy use and blue water footprint. Energy use is relatively variable, but lower for poultry and grains. Livestock is the largest contributor to greenhouse gas emissions, she added. When global livestock and greenhouse gas emissions are compared by commodity and region (in terms of CO2 output per tons of protein produced), Sub-Saharan Africa has relatively high emissions compared to the amount of output produced. She reported that greenhouse gas emissions in Africa have increased 248% in the past 5 years, which reflects the rapidly increasing production systems in African countries. When emissions are compared by species, beef cattle and dairy cattle are the major contributors to greenhouse gas emissions; pigs, buffalo, and chickens contribute less. In terms of global warming potential, mutton, goat, and beef are three major contributors with respect to CO2 per kilogram of protein produced.

48 Figure source: Global Panel on Agriculture and Food Systems for Nutrition 2016
49 Gerber et al 2013
50 Gerber et al 2013
4.2.3 Urban diet study

4.2.3.4 Study aims and outcomes

Canavan explained an urban dietary study with the goal to conduct an assessment of a developing country food system and its effects on diet, health, food security, poverty alleviation, and environmental sustainability within the context of urbanization and fragile governance structures. The two primary research questions concern (a) the impacts of protein production, access, and consumption on nutrition, health, and the environment and (b) the levels of protein source food production and consumption that are optimal for human wellbeing, environmental and planetary health. They have three specific aims. The first is to characterize patterns in animal and plant-based protein source food production, access, and consumption by food source and socioeconomic status using mixed methods including a qualitative market assessment and a quantitative household survey. The second aim is to estimate the impact of protein plant and animal-source foods on nutrition, health, and the environment, using systematic reviews and meta-analyses. The third aim is to model trends in protein production, access, and consumption on optimal (a) nutrition, (b) health and (c) environmental outcomes in Addis Ababa, Ethiopia based on results from the first two aims, and then form recommendations for action.

The study is evaluating the effects of animal and plant protein source food production, access, and consumption on the following primary outcomes: dietary diversity, household food security, adult body mass index and child stunting as well as the environmental impacts of greenhouse gas emissions and water use. Secondary outcomes include hypertension, land under cultivation, and agrochemical use. The mixed

---

51 Global Panel on Agriculture and Food Systems for Nutrition 2016
methods study comprises a quantitative household survey, a qualitative food market assessment, and optimization modeling.

4.2.3.5 Household survey and food market assessment
The cross-sectional household survey is carried out in five randomly selected subcities (out of 10) and two randomly selected woredas (districts) in each subcity (total of 10) in Addis Ababa. In each woreda, approximately 300 households were screened (total 3000) and approximately 100 enrolled (n=1000). Inclusion criteria includes households with at least one woman of reproductive age (18-49 years old), household speaks and understands English or Amharic, household provides informed consent, and household has a child between 6-59 months of age. Data collection included socioeconomic status, demographic characteristics, migration, dietary intake using a food frequency questionnaire, child feeding and dietary intake, access to food markets, homestead food production, food purchasing, household consumption patterns, food-related behaviors, women’s empowerment, knowledge of the nutritional value of food, and food preferences. Anthropometric measurements included length/height, weight and mid-upper arm circumference (MUAC) for young children (6-59 months); height, weight, and blood pressure for adult women and men.

The market assessment involved selected key informant interviews and a market survey conducted in two woredas. They purposefully selected formal and informal market vendors, urban agricultural representatives, and producers of both animal-source and plant-based protein foods serving these catchment areas. They collected data on food availability, seasonality, price, processing, preparation, marketing, and changes over time.

4.2.3.6 Progress to date
Canavan reported on their progress as of February 2018. Around 2400 households were screened and data was collected from 1050 women and 620 men (1250 households did not have children under five, 60 did not have women of reproductive age, and 35 refused to participate). Data were collected in February of 2018 by 36 field workers over a two-week period. Interviews took around 1.5-2 hours to complete for women and 45 minutes for men. The market assessment was conducted through 40 interviews with 14 vendors, including urban agricultural representatives and committee members of cooperatives in the districts. The next step is to develop a model of the food system to test interventions toward the optimization of health and environmental outcomes, said Canavan. The model will test interventions that simulate the impact of dietary policies on food and nutrient intakes, including animal protein, and estimate the changes in health outcomes based on changes in diet. It will also quantify the environmental impacts of food production on the natural environment using literature review and existing data. Canavan said in considering the broader context of the study, next steps include:

• Examining dietary trends over time
• Identifying effective strategies for shifting diets
• Creating strategies for improving agricultural practices to significantly reduce their environmental impact by improving technologies that already exist
• Looking at the impact of the food policy environment, which varies across settings
• Investigating urbanization and differences between urban and rural areas
• Analyzing contextual factors and generalizability

4.2.4 Discussion
Andy McDowell asked about the mixed method study design, noting that there was a qualitative assessment of the market and a quantitative assessment of the home. Canavan clarified that they carried out both types of assessment at the market—a quantitative survey and a qualitative interview. In the survey, they asked about the availability of different fresh and processed foods, and
seasonal availability in the market. Qualitative interviews were used to capture information beyond the household surveys, through questions such as: “How has this market changed for you in the past 5 years? Are people buying different things than they used to? Are you unable to purchase things you used to be able to?”

4.3 Homestead Food Production Interventions

In his presentation, Dominic Mosha of Africa Academy for Public Health (AAPH, Tanzania) focused on homestead food production interventions. He noted that in many developing countries, poverty and poor nutrition are major drivers of infectious disease that can be addressed by promoting strategies such as homestead food production.

4.3.1 Nutrition-Sensitive Interventions and Programs

Mosha explained that homestead food production is a type of nutrition-sensitive intervention, which are interventions carried out in non-health sectors that incorporate nutrition objectives. Nutrition-sensitive intervention address intermediate causes of malnutrition, such as improving food insecurity by promoting availability and accessibility of food. They can also bolster caregiving resources at the individual, household, and community levels to ensure that families have sufficient food supply and food diversity. The underlying causes of malnutrition, he added, can be addressed by efforts in diverse sectors. Mosha focused on interventions and programs in the agricultural sector, but he noted that efforts in other sectors can include interventions in schools and interventions aimed at establishing social safety nets, such as improving women’s income potential and establishing small business groups and village banking systems to strengthen community-wide income.

Nutrition-sensitive agricultural interventions can influence nutrition through various pathways, said Mosha. Increasing a household’s capacity for food production and improving food availability can promote dietary diversity. Increasing household income and access to food through markets can also improve dietary diversity. For example, households could sell their agricultural surplus and reap the economic benefits as well as improving the community’s access to diverse foods in the market. Agricultural interventions can impact food prices with differential impact for net sellers and net buyers. These types of interventions can also promote women’s empowerment, but he cautioned that women’s involvement in agriculture can carry certain risks (see Box 6).
Box 6. Opportunities and risks for women in agriculture

Mosha explained that involving women in agriculture provides opportunities for women as well as creating risks for them. Most importantly, it can increase women’s control over assets and resources by providing them with income from selling their produce. As a consequence, this increases women’s decision-making power with respect to food allocation, health, and care. Some women may end up relying less heavily on their sponsor or husband in their decision-making and dietary decisions for the household. However, women in agriculture may face multiple risks. These include exposure to diseases as a result of livestock management techniques, for example. Another risk is the increase in energy demand for the woman, or reduced time available for childcare. He also suggested that involving women in agriculture may promote intimate partner violence in some cases, particularly in communities that are resistant to empowering women. It might create a power imbalance or competition in a household that could incite violence against women. He noted, however, that these concerns should not discourage efforts to create a paradigm shift in communities that allows women to take a leading role. Strategies to involve men and other household members should be incorporated into women’s empowerment interventions.

Source: Mosha. Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018

4.3.1.7 Home gardens

As an example of a nutrition-sensitive agricultural intervention, Mosha described home gardens and homestead food production. Home gardening involves the production of vegetables and/or small livestock (e.g., poultry and dairy) within the household to take advantage of space and materials available on the homestead. The orange-fleshed sweet potato, for example, can be grown in home gardens and is a good source of vitamin A, proven to be effective in addressing maternal and child malnutrition. Home gardens also have a positive effect on dietary diversity.

4.3.1.8 Biofortification

Biofortification is another type of nutrition-sensitive agricultural intervention. It involves breeding staple crops that are particularly rich in micronutrients that can help address micronutrient deficiencies. The focus is typically on biofortification with vitamin A, but Mosha highlighted the need to investigate the potential for biofortification of zinc and iron to impact health. Biofortification requires certain conditions for effectiveness, he said. The target concentration needs to be achieved in staple crops and the micronutrients need to be retained and bioavailable. He noted that sustainability is an issue because cross breeding may reduce the biofortification in staple crops. Availability and cost are additional considerations that determine whether biofortification interventions are actually adopted and utilized by the targeted community.
4.3.2 Theory of change for homestead food production

To illustrate a theory of change for homestead food production, Mosha presented Figure 43. It depicts the underlying problems that these communities face, strategies to address those problems, and the ultimate outcomes and long-term impacts of implementing the strategies. For example, to address the problem of gender inequity, he suggested using gender campaigns and collective women’s action to promote women’s roles and encourage men to acknowledge their contributions. The resulting empowerment of women could increase their access to vegetable markets and potential income as well as strengthening their ability to make autonomous decisions—for example, the critical ability to take their children to the hospital if necessary without having to wait for their spouse to sponsor them. To address problems around lack of knowledge and skills, de-functioning markets, and low and unreliable crop production and quality, strategies might involve the production and distribution of seed kits to encourage homestead food production (even in tins and plastic bags for people without their own land) as well as building capacity for production, post-harvest, and marketing. By empowering them with knowledge, increased production will create a more sustainable system when surpluses end up on the market and local farmers become more self-reliant in their seed supply systems, for example. To address the problems of undernutrition, he suggested that nutritional awareness campaigns could change behaviors related to vegetable consumption and improve nutritional status.

Figure 10. Theory of change for homestead food production

Source: Mosha, Presentation at Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training 2018
4.3.3 Nutrition-sensitive homestead food production project in Tanzania

Mosha described an ongoing nutrition-sensitive homestead food production project in Tanzania’s Rufiji district. The setting has a high prevalence of undernutrition and anemia; the latter is around 60% and is linked to high prevalence of malaria in the area. The project began in 2016 with the aim of improving the nutrition and health of children and women in rural Tanzania through integrated, gender-sensitive agricultural interventions to promote nutrition and health. The existing workforce of community health workers (CHWs), agricultural extension workers (AEWs), and livestock extension workers (LEWs) are engaged to provide basic public health and nutrition education.

The project’s objectives are:

- To increase production of vegetables and fruits at the household level,
- To increase dietary diversity and consumption of micronutrient-rich food,
- To increase adoption of healthy practices such as breastfeeding, appropriate, complementary feeding, water, hygiene and sanitation practices, etc.,
- To improve women’s and children’s nutritional status, and
- To enhance women’s empowerment and their partner’s awareness of nutritional needs.

4.3.3.9 Methodology

The community-based prospective study was carried out in the Rufiji health and demographic surveillance systems (HDSS) area in ten randomly selected villages that were matched based on location, proximity to water, and population size. In each matched pair, one village was assigned to the intervention and the other as control. The Rufiji HDSS dataset was used to randomly sample the study households, with data collection points at baseline, midline, and endline. He reported that baseline and midline data had already been collected and that endline data would be collected in August 2019. Household eligibility criteria included a woman of reproductive age (18-49 years), at least one child aged less than 36 months, access to a plot of land or containers where vegetables can be grown, and the provision of informed consent. He reported that 1000 households were enrolled: 500 households across the five intervention villages and 500 households in the control villages.

The intervention package comprised agriculture inputs—seed distribution, watering cans, and fertilizers—as well as a behavioral change component. The latter component is delivered by CHWs, AEWs, and LEWs and aimed at empowering participants with knowledge to drive behavior change. This includes education about cultivating nutrition-rich crops varieties, best practices for home gardening, and food preparation, storage, and preservation. It also includes breastfeeding, complementary feeding and dietary intake as well as safe WASH practices.

Two mechanisms were used to deliver the interventions. Farmer field schools were created in each hamlet to reach 15-20 participants each through biweekly meetings where they receive information on household agriculture and nutrition delivered by AEWs, LEWs, and CHWs. The meetings also provide an opportunity for participants to discuss their concerns. The farmer field schools alternate with household visits, which are one-on-one meetings delivered by AEWs/LEWs or CHWs. He noted that extension workers are monitored by the study field manager, who visits a random sample of study households each week to check that the assigned extension worker conducted household visits and farmer field school meetings. The field manager also confirms that the extension workers have used the designated field manual to guide their discussions, visits, and presentations with participants.
4.3.3.10 Data collection and outcome measures
Data are collected electronically by trained research assistants. Data collection includes socio-demographic and economic information as well as data on self-reported recent history of illness, infant and young child feeding, dietary intake, physical activity, agricultural production, and food security. Outcomes include dietary diversity for women and children, women’s growth (BMI, MUAC, blood pressure) and anemia status, and child growth (length/height, weight, MUAC) and anemia status.

4.3.3.11 Spillover effect survey
To determine if the intervention had any spillover effect on non-participating households, they created an ancillary study. The main objective of the study was to determine the extent to which the benefits of the intervention extended beyond the primary beneficiaries as well as whether the primary outcomes of the project intervention were also attained in households neighboring the intervention households. Secondary objectives were to determine the capacity and interest of study participants in the intervention arm to share their knowledge with other villagers, to determine the extent to which farmers were able to sell their surplus produce (and how they spent the extra income), and to assess perceptions about the usefulness and challenges of the intervention. They randomly selected a sample of 400 households to receive the spillover effect survey in the five intervention villages using the same inclusion criteria as the main study. Participants reported that intervention households were willing to share their information as well as seeds they had harvested with their non-participating neighbors, enabling them to produce their own vegetables.

4.3.3.12 Progress to date
Mosha shared the project’s progress to date. Since baseline in 2016 they have provided two seasons of seeds and basic agricultural inputs. Challenges faced have include drought and water shortages in areas that already have limited access to domestic drinking water, although some participants have learned how to take advantage of wastewater. Another challenge is pest control: the study discourages the use of harmful pesticides. Participant retention is also a serious challenge because people frequently leave their villages for a variety of economic and personal reasons. Finally, the availability of manure is an issue because most participants do not keep animals. They are now teaching participants how to produce compost.

4.3.4 Impact assessment of nutrition-sensitive interventions
Mosha commented that many nutrition-sensitive interventions have not yet shown an impact on nutrition outcomes. He explained that there is a wide range of ongoing interventions—both direct nutrition interventions and nutrition-sensitive ones—but that integrating interventions makes it difficult to assess the impact of specific interventions. It is also difficult to show impact on nutritional status due to the time lag and the multiple determinants of stunting beyond malnutrition. Adequately assessing the impact and outcomes of interventions will require rigorous methodology in terms of sampling, randomization, and the presence of matched control and intervention groups.

4.3.5 Optimal mix of interventions
Mosha concluded by noting that the optimal mix of interventions—both nutrition-specific and nutrition-sensitive—increases the chance of success in a population. However, each setting requires a particular mix of tailored interventions depending on the context. Targeted populations need to be willing to engage with the interventions to achieve the maximum impact in improving agriculture, nutrition, and empowerment. Institutional capacity is another important factor: institutions need to be ready to support the intervention through the existing agricultural sector or by building capacity. Extension workers are critical in delivering
the intervention in Rufiji, for example, but they need to have the resources to do so. Nutrition-sensitive interventions benefit from the involvement of multiple sectors, he added, but it is important to avoid competition between different sectors, such as health and agriculture.

### 4.3.6 Discussion

Seth Adu of the University of Ghana asked how the project is ensuring sustainability. Mosha said that they are working within the existing agricultural sector. The sector is supported by existing extension workers who have been equipped with knowledge to deliver the intervention. He said that self-reliance in being able to harvest one’s own seeds is another important part of sustainability that the intervention is promoting. They are also working to help village leaders appreciate the intervention and exploring ways to help women gain support from their husbands for the initiative. Fawzi asked about the intervention’s potential impact on overnutrition. Mosha replied that although the focus is primarily on undernutrition, there is some messaging about the consequences of over-nutrition to help mitigate the risk of increased rates of obesity.

### 4.4 SCHOOLS AND URBAN FOOD SYSTEMS WORKING GROUP PROPOSALS

Lindsay Jaacks described two proposals discussed by the working group on schools and urban food system. The first proposal targets low fruit and vegetable intake in urban areas in the developing countries of Ethiopia, India, and possibly Tanzania. There are two pieces that can be started immediately—a review of policies related to fruits and vegetables in the target cities and a market basket audit in India. For the latter piece, the group suggested using existing tablet-based data collection tools to gather data on price, availability, and quality of a preselected list of fruits and vegetables in all markets that sell them. The third step, which will be more time-consuming, is to apply network theory to the fruit and vegetable markets in the target cities by interviewing key stakeholders and then interviewing the people they mention. For example, a street food vendor might mention the wholesale market where they source their food, who could then be asked about the farms from which they purchase foods. Other innovative pieces might be added, such as tracking street food vendors using mobile applications. The goal of the intervention is to better understand the determinants of consumption in these settings. Much of the data gathered will pertain to answering questions around two variables, which are also the key barriers: the safety and price of fruits and vegetables. Once completed, these three steps will provide an understanding of the specific predictors of price and safety, in terms of pesticides and bacterial contamination, and will thus facilitate the development of interventions that can be piloted and tested. The three initial steps will also provide baseline data for evaluating those interventions.

The second proposal relates to understanding and quantifying the food-related microenvironment around schools, said Jaacks. This will involve developing a cluster-randomized trial to test different interventions to improve that microenvironment around schools in different districts. An example of such an intervention might be creating a perimeter for unhealthy foods around schools, much like the common 500-meter perimeter restriction for selling tobacco around schools. She said the group discussed priorities in terms of issues faced by adolescents in these cities. For example, Uganda and Ethiopia seem to have much more pressing issues related to drug use among adolescents than Tanzania. Scaling up to multiple countries would require expanding the targets of the intervention, she added.

During the discussion, Yemane Berhane of Addis Continental Institute of Public Health (ACIPH, Ethiopia) argued that banning junk food is not the solution, because laws already exist that are not being enforced. In his experience, closing down vendors near
schools only works temporarily. Instead, interventions should focus on suppressing demand and helping adolescents to make informed decisions through community-wide efforts in homes, schools, and other settings. Yousafzai described a qualitative method used in a pilot study to help shape demand in households by working in rural schools. They found that parents prefer to buy unhealthy snacks for their children to take to school, rather than sending them with healthier homemade snacks, because it is an indicator of status that shows they can invest in their children. They have worked to shape and change the demand side with families and in schools rather than targeting vendors. She reported that in the pilot’s preschool environment, changes have been observed in what students were bringing in for their lunches. She noted that it was not a nutrition-focused project, but one focused on holistic wellbeing in the classroom.

To a question about starting the intervention by collecting data from vendors, Jaacks clarified that they want to collect data on food price and safety (in terms of pesticides and contaminants) at each node in the food system. The concern about starting with vendors is that they might not be able to backtrack, because vendors may not willing to share the sources of their food. Starting with markets and tracking forward will provide a better picture of the nodes where data need to be collected. One of her planned projects is to understand the life cycle of an apple in Delhi, for example, which will require knowing where those nodes are to answer questions about where the apple came from, where it may have been exposed to contaminants, why it is priced the way it is, and so forth. Jaacks also elaborated on the mapping component of the proposal. They are working on GIS mapping of every food outlet in a certain district of Delhi where people access fruits and vegetables. Participants discussed the potential to map food vendors and integrating the market basket audit directly into the GIS data collection.

Wafaie Fawzi noted that a sizeable proportion of adolescents attend school and wondered whether it would make sense to use schools as an entry point by carrying out a basic survey of the “school ecosystem”: that is, the vendors around schools, the canteens within schools, the quality of food available, and perhaps access to drugs near the school. He also suggested the idea of adding modules to school curriculums around drug use, sexual and reproductive health, and/or nutrition. Participants discussed how the utility of schools as an entry point depends upon the proportion of adolescents attending school in various settings, noting that schools in urban areas tend to have higher enrolment than those in rural areas.

Emily Smith of the Harvard T.H. Chan School of Public Health (U.S.) noted that younger adolescents tend to eat most of their food away from home, while older adolescents tend to eat more of their food at home. She reported hearing claims that populations do not have access to processed snack foods. She suggested that to enable national scale up of these types of interventions, it would be useful to align with food categories that are tracked by the private sector: “snack/junk/processed” food is not a category that is tracked in terms of sales. Participants agreed that this may be worth addressing.

In terms of using schools as an entry point, Dhillon noted that WHO guidelines around physical activity and diet for adolescent health promotion relate to the access available around school environments. Extending the work in tobacco perimeters around schools to unhealthy foods may help to address those guidelines, she said, but more evidence is needed to understand to what extent the proximity of schools to unhealthy food may be important. There are other drivers around adolescents’ influence on household food choices and patterns that may or may not be driven by the foods they can access near school campuses, because guidelines should not be established nor policies informed without the requisite evidence.
Sudfeld noted that just because a shop sells ice cream outside a school does not necessarily mean the students are buying it there, just as physical activity does not necessarily increase because green spaces are nearby. He also remarked that children buying unhealthy foods must be getting money from their parents, suggesting that it might be useful to look into how much money they are getting, for example. Jaacks replied that they do not sample the students about where they are purchasing different foods, nor have they questioned parents about money they might provide. Finlay suggested the idea of geographically tracking adolescents on their commutes between home and work or school to see where they are stopping.

**4.5 HOMESTEAD FOOD PRODUCTION WORKING GROUP PROPOSALS**

Chelsey Canavan reported back from the working group on homestead food production at different community levels. According to Canavan, the group discussed using an intervention to examine the combined effects of school gardens and homestead food production programs on adolescent nutritional knowledge and dietary diversity. Given that adolescents have significant input into food preference in their households, the intervention would aim to provide them with knowledge and interest in growing fruits and vegetables. Thus far, school garden programs have not generated very good results in terms of improved dietary intake, despite increases in knowledge. The intervention is designed to address improved dietary intake through its combined program that focuses on adolescents, but also targets the family and entire household. It would include education about the importance of diet and dietary diversity; the intervention could also be incorporated into a school meal program by supplementing the school meals with additional vegetables. They also discussed training youth groups on seeds and seed distribution through an after-school, community-based program that might contribute an additional beneficial spillover effect. Surplus produce from school gardens might also be used to supplement schools’ expenses, such as teachers’ salaries. School and community garden settings provide opportunities to incorporate other technologies that are not feasible at a household level; for example, solar dryers could be used to preserve food and increase food security, especially during lean seasons. In terms of study design, they discussed randomized trials at the school level, potentially with one school-based, one homestead-only arm, one arm that does both, and a control arm. The design would enable comparison of the combination versus school or homestead gardens alone. Outcomes would include dietary intake, knowledge and preference of vegetables, dietary diversity, food security, and the potential for income. They discussed rural settings in Ethiopia and Tanzania as potential intervention settings, she said. During the discussion, Finlay suggested adding school retention and delayed age at marriage as outcomes.

Canavan clarified that they would include both male and female adolescents, beginning by targeting adolescents in schools and reaching their households through them. This would apply to both school and homestead gardens to ensure that the study populations were comparable—participants in the homestead garden only arm would not have the school garden component, but they would still enroll participants through school settings and then work at the household level to promote home gardening and dietary diversity. The school setting was selected because homestead production programs generally have not been focused on adolescents, but their parents. The intervention is designed to look at the engagement of a new generation of adolescents. Fawzi added that the homestead production arm should not only involve adolescents taking the message home, but also actively enabling and supporting households by visiting, providing seeds, and so forth. Yousafzai cautioned that the intervention might experience pushback
from the education sector. She advised that assessing the intervention’s burden on the education system—e.g., the amount of time it would co-opt from teachers and other goals they must achieve—and building that into the business case will be critical for getting buy-in.

Participants discussed how garnering interest in farming interventions may vary across settings, because they may not be perceived as particularly exciting to adolescents. It was suggested that in urban areas farming might be more of a novelty, and thus more interesting, than it would be for adolescents in rural areas. Adding an after-school component of the school garden intervention might be explored in urban areas, where parents may be more eager for such activities to keep their children occupied.

Jaacks described the other proposal from the working group: a farm-to-hospital program. It was originally envisioned in the context of a setting like Guatemala, where there is a high prevalence of chronic under- and over-nutrition. Chronic over-nutrition (overweight and obesity) is mainly associated with mothers, whereas children tend have chronic undernutrition and stunting. The intervention was designed to address both ends of the malnutrition spectrum. The model is adopted from Boston Medical Center hospital in Boston, in which the health care sector hired a farmer to grow fresh fruits and vegetables to fill the hospital’s pantry. Patients meet with and receive prescriptions from a health care professional for pantry fruits and vegetables. In considering the potential implications of this type of intervention in settings like Ethiopia, they decided a background of food security would be required for a program like this to work. It is not meant to be a feeding program, but a supplemental, transitional intervention around increasing fruit and vegetable intake. She also suggested that such interventions would be better suited to urban areas in which someone would be hired under the study grant to run the farms involved. If it is demonstrated to be a cost-effective approach, then when it is scaled up, this farmer would be part of the health care team.
5 Health and demographic surveillance systems

5.1 LONGITUDINAL HEALTH AND DEMOGRAPHIC SURVEILLANCE SYSTEMS

An overview of how health and demographic surveillance systems (HDSS) have been designed and implemented in developing countries was provided by Nega Assefa, Haramaya University, Ethiopia. He explained that HDSSs are ultimately for collecting data in developing countries, where resources for data generation and decision making are constrained. This is not the case in many developed countries, where economic, health, and nutritional data are available to decision makers and allow them to make policy or executive decisions based on evidence. To address this lack of data, many countries in Africa have established HDSS sites to register demographics in a specific area. Because they are geographically limited to specific areas, they do not generate data for the entire country. The process begins with an initial census, in which unique identification numbers are assigned to everyone in this dynamic cohort. Changes in that population are then tracked through follow up of pregnancies and their outcomes, out- and in-migration, and deaths.

HDSS sites exist across Africa and Asia, said Assefa. INDEPTH Member HDSS sentinel surveillance countries include Senegal, the Gambia, Guinea-Bissau, Burkina Faso, Ghana, Nigeria, Ethiopia, Uganda, Kenya, Tanzania, Malawi, Mozambique, South Africa, India, Bangladesh, Thailand, Vietnam, Indonesia, and Papua New Guinea. As the number of sites in a country increases, the data becomes more representative of that country. He reported that in Ethiopia, the number of HDSS sites increased from six to ten between 2016 and 2018.

Assefa described some of the characteristics of health and demographic surveillance systems. An HDSS is a standardized, population-based information system that is established in geographically defined sections of impoverished communities to facilitate monitoring of demographic and health changes. Regular repeated visits (often every three to six months) enable prospective collection of longitudinal population, health, and socioeconomic data. A standardized information system allows for information to be generated across sites in the same way and provides a versatile platform for any kind of policy evaluation or intervention testing. The entire population is registered in the system and the population data may be linked to service utilization data in the health system, the school system (e.g., to monitor attendance), or the civil registration system, for example. Systems often have a set of core modules that are measured each year, with other modules added or removed from the system as resources and time permit. These modules might include residence status, education, labor, household assets, temporary migrations, child care grants, health care utilization, food security, adult health, father support, and vital documents.

5.1.1 Health and demographic surveillance system in Kersa and Harrar, Ethiopia

Assefa outlined the four core objectives of the health and demographic surveillance system in Kersa/Harrar, Ethiopia:

• To generate up-to-date community-based health data
• To conduct studies in addressing national health needs
• To monitor trends of demographic, health, and environmental changes
• To evaluate health intervention activities, either side by side or sequentially
A geographically defined district in Kersa was selected as the HDSS site, with the system running in each of its subdistricts. In both Kersa and Harar, certain surveillance activities are carried out every round, while others are carried out intermittently on a regular schedule. Demographic data is collected during every round, with the main demographic surveillance modules including births, pregnancy outcomes, deaths, in- and out-migration, and marital status changes. Intermittent health surveillance modules include morbidity (carried out during even rounds), immunization status (odd rounds), family planning (even years), economy (every five years), and education (every two years).

In the Kersa HDSS, non-regular activities are also linked with the main demographic activities for the sample frame or other basic characteristics of the study subjects. For example, an ongoing pneumococcal conjugate vaccine observational study was initiated in 2011 in collaboration with other surveillance sites and has now been taken over by the Ministry of Health. Other non-regular activities that have been integrated into the data collection include the ARISE Adolescent Health Study (2015-2016), Child Health and Mortality Prevention Surveillance study (CHAMPS, 2017), the Water, Diarrheal Disease and Climate Change study (2016), and ongoing PhD, Master's, and staff research.

5.1.2 ARISE study in Kersa and Harar

Assefa provided more specific details about the ongoing ARISE Adolescent Health Study in Kersa and Harar. Its objectives are to describe the health status of adolescents aged 10-19 years and to assess the individual- and household-level factors associated with health status and behavior. The study’s focus areas—per the ARISE Network’s standardized questionnaire—include: socio-demographic characteristics and schooling; substance use and mental health; diet and nutrition; physical activity; sexual behavior, sexually transmitted infections, and reproductive health; health status, health care, and quality of life; media use, protective factors and parents; health care use; and violence and bullying. The methodology uses a community-based cross-sectional study in the Kersa and Harar HDSSs in which the ARISE Network questionnaire was administered to an overall sample size of 2400. Data were collected by HDSS field workers. Weight and height were measured in addition to the survey administration.

5.1.2.13 Study results

In terms of population distribution by age and sex, the trends in Kersa and Harar both appear similar to the broad trend in developing countries. The population is distributed in a pyramid-like shape, with larger proportions of the population under the age of 44 compared with the proportion aged over 45 years. In Kersa, around 55.5% of the study population were male while in Harar, men represented 47.2% of the study participants. In terms of age distribution of the study population in Kersa, 61.1% were aged 10-14 years, 27.0% aged 15-17 years, and 11.8% aged 18-19 years. In Harar, 53.1% were aged 10-14 years, 32.2% aged 15-17 years, and 14.7% aged 18-19 years. He noted that this distribution may be affected by inconsistencies and incompleteness in responses.

Assefa provided an overview of some of the ARISE study findings. Figure 51 illustrates stunting outcomes in Kersa and Harar. He noted that stunting is significantly lower in Harar, which is an urban environment, than it is in the rural setting of Kersa. The data also indicate that stunting is more common among males than females.
5.1.2.14 Challenges and opportunities

Assefa outlined some of the problems faced during the ARISE study and proposed some solutions. The first problem is the failure to capture data from adolescents during home visits. He suggested that future studies including adolescents could address this problem by implementing a school-based study coupled with search and match strategy for basic household characteristics. Searching and matching adolescents’ data to their households would be possible because of
the household and individual identification numbers assigned within the HDSS. Another problem is participants’ non-willingness to allow measurements such as weight, height, and MUAC. A clearer explanation of the purpose of the study may help this problem, he suggested. Underreporting is another problem, particularly in the areas of sexuality, reproductive health, and substance use. For example, only around 10% of adolescents in both Kersa and Harar reported being sexually active, which Assefa said is unrealistic. The same holds for substance use. Both Kersa and Harar are located in an area where chat is a common cash crop that many people chew, but chat use was very underreported in the study. He suggested that using an interviewer-guided but self-administered questionnaire—with the interviewer reading the survey questions but the respondent answering privately—coupled with a qualitative study might help collect more accurate data.

Assefa remarked that it would be possible to integrate an adolescent health study into the regular HDSS activities, but it would require making some adjustments. This would include abridging the original 20-page questionnaire to two pages; he suggested that for such a questionnaire to be part of regular surveillance activities, it needs to be brief enough that respondents are willing to complete it repeatedly. He noted that the original survey had ten focus areas, and their revised version could focus on just four—sexual and reproductive health, nutrition, substance use, and health care. He also suggested using the local language in electronic versions of the questionnaires administered using tablets, as well as translating the responses into spreadsheet files that can be integrated into the broader surveillance system. Finally, he suggested that field workers need better training and that rounds should be done every other year to ameliorate the field work load.

Assefa anticipated some challenges that might arise while integrating an adolescent health study into regular HDSS activities. For example, he questioned whether such a study would be an appropriate HDSS activity in terms of the potential effects of fatigue and issues with validity. He questioned whether adolescents would continue to respond validly if they are repeatedly asked the same questions. The questionnaire would need to be made ever shorter to align with regular HDSS activities, but this runs the risk of losing important information. He also predicted underreporting in key areas, so he suggested it might be better to focus only on adolescent nutrition and malnutrition, for example.

Integrating an adolescent health study would also place an additional burden on field workers and the budget would be strained by hiring additional field workers to carry out the survey during odd years. A methodological issue concerns the merits of a longitudinal repeated measure versus a repeated panel.

Assefa concluded by offering two questions for future research. Given the significant disparity between male and female adolescents and between adolescents living in urban versus rural settings, he suggested looking at the drivers of malnutrition among those groups in the two settings. This could shed light on why females tend to have better nutrition and why adolescents in urban areas tend to be better nourished. The second question concerns how best to approach the underreporting and misreporting of sexual and reproductive health issues and substance use.

### 5.2 Longitudinal Demographic Surveillance Systems Working Group Proposals

Assefa reported that the working group on longitudinal demographic surveillance systems discussed possibilities for integrating ARISE Adolescent Health Study and HDSS activities. One option is to follow a specific sample throughout the adolescent period; other options would be to use a serial cross-sectional sampling approach or sample all adolescents in each HDSS round. It may be possible to merge data sets together and analyze them with a standard set of questions and follow up methods. Many countries with

---

52 Chat is a flowering plant containing the alkaloid cathinone, which is a stimulant with amphetamine-like effects.
HDSS (including Ghana, Uganda, and India) would like to integrate the activities, but the best method of doing so across all the sites needs to be determined. He suggested that it is possible, provided that the abridged form of the adolescent questionnaire is used across sites (i.e., the two-page version reduced from the original 20-page version). He suggested focusing on the areas of sexual and reproductive health, nutrition, and substance use in the abridged questionnaire. Nutrition elements should focus on anthropomorphic measurements and dietary habits, he suggested. ASRH could also be included in the serial approach and integrated into the system. He emphasized that elements integrated into the HDSS system must be very short to avoid fatigue among respondents in communities. Adding or integrating activities to the existing HDSS needs to take into consideration the additional costs and resources that would be required. The best methods for questioning adolescents about sexual and reproductive health for adolescents is also an issue that needs attention—for example, using an assisted self-administered questionnaire or a questionnaire in tablet format. Finally, the group suggested that experts might visit sites to collaborate with HDSS leadership (e.g., ministers of health and education) about the potential for introducing new elements into the system.

During the discussion, participants discussed whether the same two-page questionnaire would be used whether all adolescents are captured in the HDSS or if there would be a sampling each round. Assefa noted that it depends upon the surveillance method selected—whether the questionnaire is administered to a sample or the entire adolescent population. The latter would be a longitudinal study, but the former option would require making a decision about whether the survey would be administered to specific adolescents year by year or to a panel. He noted that there are a few dietary questions on the short-form survey, due to space constraints.

A participant remarked that it is challenging to use the HDSS platform to collect information; it requires selecting indicators that may not be collected reliably or regularly because they require special studies or a full census every 4 or 5 years. He suggested selecting just five questions in all the focus areas, because it is a waste of resources to collect larger amounts of data that are not reliable. Privacy is also an important issue when discussing sexuality with adolescents; the information collected by the HDSS are publicly available.

Assefa noted that questions should be aligned with key goals, such as the SDGs. He agreed that the response rates regarding sexual and reproductive health and substance use are poor, but instead of abandoning the issues, he suggested using serial pilots to find the best ways to ask and analyze these questions instead of just integrating them one time. The participant suggested using HDSS as a sampling frame: that is, select a reasonable sample and make a complete assessment, instead of going to every household and asking only a couple of questions that will not actually tell you anything. He suggested that this would make the study less expensive but also provide more complete, reliable information. Reaching adolescents through a separate sample might be easier than trying to reach them in the context of the entire household, a participant added. It was noted that HDSS is not designed to interview adolescents—they interview the head of the household or the spouse. Asking field workers in the normal HDSS cycle when adolescents are not likely to be at home might cause people to be suspicious of the workers trying to search for their adolescents. When HDSS is carried out, there are usually 10 or 15 people present listening to the questions and assisting. It is a very quick process and the data collection workload is actually very minimal.
6 Synthesis and ways forward

During the final session of the workshop, participants discussed short-term interventions factoring in limited scope and expense, larger interventions requiring more time and resources, and opportunities for publishing and dissemination of research.

6.1 SHORT-TERM INTERVENTIONS FACTORING IN LIMITED SCOPE AND EXPENSE

6.1.1 Market basket audit
Dhillon suggested the market basket audit, which is a ready-made tool that could be modified and does not require ethical review. It involves creating a checklist of pre-specified foods and checking the availability of each item in a sample market or food outlet. Data are collected to identify outlets where fruits and vegetables are available to purchase, where they are affordable, and where they are safe (if anywhere). The aim is to promote and develop policies to increase the number of outlets selling safe, affordable fruits and vegetables and to decrease the number selling unsafe and expensive ones, which requires understanding the food system around fruits and vegetables in order to intervene. The first step is trying to grasp where things are in terms of prices and quality.

6.1.2 School-based surveys of food ecosystem and fruit and vegetable intake
Participants discussed school-based surveys of food ecosystem and fruit and vegetable intake. This would be an opportunity to capture more detailed information beyond students to school administrators and vendors near the school; another possibility is GIS mapping of the school ecosystem and what is being sold around the perimeter (see the WHO nutrition friendly school initiative).

6.1.3 Workshops with adolescents about approaching sensitive topics
Participants suggested holding a workshop with students as an innovative way to learn from adolescents themselves about how they would like to discuss sensitive topics, such as sexual reproductive health, violence, and substance abuse. Workshops or focus groups would provide an opportunity to ask them what works, what does not work, what are they comfortable with, and so forth. This might involve providing them with examples of different communication strategies for them to role play, test out, and share their thoughts.

6.2 LARGER INTERVENTIONS REQUIRING MORE TIME AND RESOURCES

6.2.1 Integrated interventions to delay marriage, delay pregnancy, and improve nutrition
Participants discussed a larger project that could involve integrated interventions to delay marriage, delay pregnancy, and improve nutrition. Delayed marriage interventions and outcomes would relate to structural issues, empowerment, and retention in school, for example. Girls who become married and pregnant would be followed through the delivery to see the impact of delayed marriage on functional outcomes, like maternal health or fetal outcomes.

6.2.2 Integrated two-generational intervention
Integrated two-generational interventions to promote child health and women’s

---

53 In Delhi, they developed the list based on existing dietary data for the city, but it does not have to be the same across settings.
54 Jaacks asked about the GIS process for mapping out food outlets in a single district in Delhi. Dhillon explained that they mapped households and then calculated the center of each separate neighborhood. They delineated a 1 km buffer around each neighborhood that was physically visited by a team of field workers who collected GIS data about the locations of facilities and shops. For all of Delhi, the process took about 5-6 months, with each neighborhood taking around 2-3 days.
empowerment were also discussed. The first arm of the proposed trial/study would strengthen child interventions within the country’s existing health service during the child’s first 1000 days (e.g., strengthening growth monitoring information and integrating parenting interventions). The second arm extends into the community with a series of women’s empowerment interventions (e.g., microfinance or vocational training) to look at the impact of targeting the family, women’s autonomy, family member’s mental health, and additional benefits to the child.

6.2.3 Interventions around anemia and/or undernutrition among adolescents

Participants discussed interventions around anemia and/or undernutrition among adolescents. Interventions proposed for anemia included daily, weekly, or biweekly iron supplementation for adolescents in and out of school. Interventions proposed for adolescents aged 15-19 years who are underweight (no guidelines exist for this group, despite the high prevalence of undernutrition) included individual counseling, school feeding programs, fortified milk, growth monitoring, protein and/or calcium supplementation.

6.2.4 Policy intervention to target fruit and vegetable consumption

A policy intervention to target fruit and vegetable consumption was also suggested. It could be a multi-country study with districts randomized to receive the intervention, and assess the impact on fruit and vegetable consumption.

6.2.5 Smaller studies to inform school-based interventions

Participants discussed smaller, school-based studies to identify interventions that would be feasible to create a healthier school ecosystem—e.g., a school-based survey or mapping study. The survey might be broader than fruits and vegetable consumption and extend to vendors or curricula around nutrition in schools, for example. A broad preliminary understanding of the situation could inform the next phase of interventions. A possible barrier is that developing the network of schools to participate can be a difficult and lengthy process.

6.3 OPPORTUNITIES FOR WRITING AND DISSEMINATION

In the context of opportunities for writing and dissemination, participants discussed key themes that could be addressed. These include: nutrition across households in developing countries (including children, pregnant women, adults, and the elderly), dual burdens of malnutrition in developing countries, food systems, prioritizing food groups, intrahousehold distribution of resources, gender differences, access and affordability of foods, behavior change, and cultural context around what is healthy.

Participants offered the following specific suggestions for writing outputs:

- Commentary and/or review of the literature and existing country data around the triple burden of nutrition across the life cycle
- Review of policies around adolescent nutrition
- Review of policies around school health programs (addressing the dual burden, life-course approach, nutrition guidelines, and nutrition data from country-specific programs)
- Policy brief about nutrition priorities and strategies for adolescents
- Paper with an advocacy goal (e.g., framed around the SDGs) to compensate for the lack of data
- Paper focused on interventions for adolescent wellbeing rather than prevalence data
Appendices

APPENDIX A. WORKSHOP AGENDA

Global Nutrition for Adolescent and Family Health: Innovations in Research and Training

Harvard Medical School Center for Global Health Delivery-Dubai

Mohammed Bin Rashid University (MBRU), Building 14, Dubai Healthcare City, Dubai, United Arab Emirates

THURSDAY, FEB 15: Pre-Workshop

Participant arrival in Dubai

FRIDAY, FEB 16: Workshop Day 1

8:30am  Depart Grand Hyatt for MBRU - 8:30am sharp (walking ~10 minutes)
9:00am  Welcome
        Wafaie Fawzi
9:15am  Overview of CGHD-Dubai
        Salmaan Keshavjee
9:30am  Intro to Adolescent Nutrition
        Chris Sudfeld
10:00am Adolescent Sexual and Reproductive Health – Preventing Child Marriage
         Jocelyn Finlay
10:30am Break
11:00am Integration with Early Childhood Development
         Aisha Yousafzai
11:30am Demand Creation for Youth-Friendly Services
         Abu Manu
12:00pm Homestead Food Production Interventions
         Dominic Mosha
12:30pm Sustainable Urban Diets-Addis Chelsey Canavan
1:00pm  Lunch
2:00pm  Urban Food Systems  
   *Preet Dhillon*
2:30pm  **Working Group Session 1**  
   Adolescent anemia  
   *Chris Sudfeld*  
   Sexual and Reproductive Health  
   *Jocelyn Finlay*
3:30pm  Break
4:00pm  Report back & group discussion
5:00pm  Depart MBRU for hotel (walking ~10 minutes)
Evening  Dinner at leisure - Grand Hyatt

**SATURDAY, FEB 17: Workshop Day 2**

8:30am  Depart Grand Hyatt for MBRU - 8:30am sharp (walking ~10 minutes)
9:00am  **Working Group Session 2**  
   Schools & urban food systems  
   *Lindsay Jaacks*  
   Mental health & child development  
   *Aisha Yousafzai*
10:30am  Break
11:00am  Report back & group discussion
11:30am  Longitudinal Health and Demographic Surveillance  
   *Nega Assefa*
12:00pm  **Working Group Session 3**  
   Longitudinal DSS  
   *Nega Assefa*  
   Homestead food production  
   *Chelsey Canavan & Dominic Mosha*
1:00pm  Lunch
2:00pm  **Session 3 continued**
2:30pm  Report back & group discussion
3:00pm  Wrap up & next steps  
   *Wafaie Fawzi*
4:30pm  Depart MBRU for hotel (walking ~10 minutes)
7:00pm  Bus departs from Grand Hyatt Bus to Dubai Mall
7:30pm  Group dinner at Abd El Wahab
10:00pm  Bus departs from Dubai Mall Return to Grand Hyatt
APPENDIX B. LIST OF WORKSHOP PARTICIPANTS

Global Nutrition for Adolescent and Family Health: Innovations in Research and Training

Harvard Medical School Center for Global Health Delivery-Dubai
Mohammed Bin Rashid University (MBRU), Building 14, Dubai Healthcare City, Dubai, United Arab Emirates

Seth Adu Afarwuah University of Ghana
Nega Assefa Haramaya University, Ethiopia
Anamitra Barik Society for Health and Demographic Surveillance, India
Alexandra Bellows Harvard T.H. Chan School of Public Health, US
Yemane Berhane Addis Continental Institute of Public Health, Ethiopia
Justine Bukenya Makerere University School of Public Health, Uganda
Chelsey Canavan Harvard T.H. Chan School of Public Health, US
Preet Dhillon Public Health Foundation of India
Wafaie Fawzi Harvard T.H. Chan School of Public Health, US
Jocelyn Finlay Harvard T.H. Chan School of Public Health, US
David Guwatudde Makerere University School of Public Health, Uganda
Safraj Shahul Hameed Public Health Foundation of India
Lindsay Jaacks Harvard T.H. Chan School of Public Health, US
Abubakar Manu University of Ghana School of Public Health, Ghana
Dominic Mosha Africa Academy for Public Health, Tanzania
Ramadhani Abdallah Noor Africa Academy for Public Health, Tanzania
Rajesh Kumar Rai Society for Health and Demographic Surveillance, India
Emily Smith Harvard T.H. Chan School of Public Health, US
Christopher Sudfeld Harvard T.H. Chan School of Public Health, US
Aisha Yousafzai Harvard T.H. Chan School of Public Health, US
References


Toxics Link. POP’s in South Asia: Status and environmental health impacts. 2004.


PROCEEDINGS

Advancing Global Nutrition for Adolescent and Family Health: Innovations in Research and Training

ISBN-10: 1-944302-12-3