

The BOND-KIDS Project Exploring the Nutritional Ecology of School-Aged Children Webinar

Webinar Transcript

Andrew Bremer

Thank you, Alison. I promised everyone less than 20 seconds today. I'm sitting here watching the chat, what an amazing group of individuals, and I appreciate. What an international audience that we have today. Thank you for making time and you [unintelligible 00:00:18] and everyone at USAID Advancing Nutrition, I want to thank you for your support. Quite frankly, I just have a pleasure every day of going to work with some really outstanding, amazing individuals who are dedicated to making a difference.

I would love to kick off today by recognizing my colleague, Dan Raiten, who you're going to hear from in a minute. Dan is not just a tour de force in the field of nutrition, his dedication and passion for making a difference in this space is both infectious and just inspiring. I want to call out Dan and just say a huge thank you to Dan. To Alison Steiber and her team at the Academy of Nutrition and Dietetics, they have been our right-hand partners for many endeavors over the years and certainly what you're going to hear today and hopefully in futures webinars down the road, only have it because of their supports and help on so many levels.

Also, before I turn over to Dan, I want to thank all of our working group chairs and all the speakers today. When we do these projects at the institutes and other venues, we recognize that we ask people to dedicate their time and their energy on top of their full-time jobs. It's a pleasure to not just work with some really talented individuals but to think with them, to collaborate with them, and to really put our heads together about ways to move the field forward and make a difference. To all the speakers today, all the working group chairs who you'll hear sequentially throughout the presentation today, just a profound appreciation and gratitude.

With that, I went over my 20 seconds, so whoever bet on me not to, I've been talking for more than 20 seconds, so you've now won, but I will, again, end by just saying thank you. Thanks, everyone, for tuning in, and thanks to our speakers. Dan, take it away.

Daniel Raiten

Thank you, Joe. Before starting, I just want to acknowledge that none of this happens without Drew, the leadership at NICHD, and the leadership of the Global Nutrition Coordination Plan, who have all been very supportive of these efforts. As you [unintelligible 00:02:34] mentioned, this is part of the Global Nutrition Coordination Plan, which is organized around a number of technical working groups. This particular workshop is under the aegis of the ecology of parent-infant and child nutrition.

The Global Nutrition Coordination Plan has been around since 2016. We're in our second five-year iteration. In the first iteration, we had a work group focused on the 1000 days. Understandably, that was a and continues to be a major focus of the global community, but we are now learning. I think we've

always understood, but I think we're now acknowledging the importance of those subsequent developmental stages that covers the range of school-aged children, so that 7000 days. The Global Nutrition Coordination Plan in its second iteration expanded its coverage to emphasize the importance of child nutrition through adolescence.

That's the focus of this workgroup. Next slide. Next. I have no conflicts, at least not that I can talk about. My psychologist might differ. Next slide. This is a project under the aegis of NIH. Our focus as a biomedical research organization is to really focus on the biomedical research, but we recognize the importance and the balance between basic research, biomedical research, and the translation of that research to inform assessment and implementation, science programs, et cetera. This balance is at the core of what we do and you'll see this project that sits of a high priority. Next slide.

With regard to translational science, we recognize that and this is an important part of the Global Nutrition Coordination Plan, is that the plan really does recognize the importance of translational science that is taking information, basic science, and translating it throughout the continuum of effort. It really acknowledges the spectrum of players involved in the development and implementation of evidence-based programs and policies. This is the definition from the National Center for Applied Translational Science. Next slide.

This cartoon just represents the continuum of effort in translational science that we try to represent this project and through the GNCP. Next slide. This slide really just acknowledges, in a very simplistic way how the GNCP works through the member agencies and the US government, as well as our partners internationally. We'll hear from several agencies in the UN system and other agencies today on our panel, but we recognize that there is this continuum. It looks linear, but in fact, it's not because at each stage there is data that develops, and those data that are constantly fed back into the system to inform each stage. This is an important part of what we're trying to do here in this project, certainly, and overall the Global Nutrition Coordination Plan. Next slide, please. Next.

The project is called Bond Kids, and there's a reason for using the Bond platform for those of you that may be familiar with the Bond platform. For those of you who may not be familiar with it, it started in 2010 as a collaboration with the Bill Melinda Gates Foundation, other agencies and organizations, offices at NIH, and other agencies around the global community. Its goal is really to explore all aspects of discovery, development, and deployment of methodologies for assessment of nutrition to build consensus, explore the evidence, and move the process forward, recognizing that there are multiple user groups involved in this enterprise.

Starting again, using that translational spectrum, starting with the basic researchers, clinicians, program policy people, and the stakeholder community that are tasked with providing resources and engagement with the community, and actually implementing these programs and policies. Next slide. The specific aspirations of this project are to really engage the community, the larger community, to explore the evidence yet. The real emphasis here is on the evidence. Our efforts here in this project was to explore what we know and what we don't know.

How do we take that evidence, how do we fill those gaps, and how do we use those evidence to help support the efforts of all the agencies and organizations represented by you folks, who are actually boots on the ground dealing with kids and families? Our goal here is not to develop policies and recommendations. It is, in fact, to support those agencies and organizations that do do that. Next slide. Throughout this process, we're going to use the term ecology. By ecology, we're referring to a complex biological system and its interactions with its environment. In this case, it's the child, the child that

represents a very complex system. It has an internal and an external ecology. This project was designed to explore those environments. Next slide.

There are multiple ecologies that we're going to address here in this project. This is just a cartoon representing a holistic view of the environment. We're not just talking about the physical environment, but in fact, the internal and external environment below and above the skin, if you will, of a child. These are just some of the factors that are being explored. Next slide, of course, a major driver for the need for the school meals and programs to support nutritional care of the school-aged children is food and nutrition and security. These are some of the factors that affect those ecologies, and they are important considerations in everything we did in this project. Next slide.

Of course, the food system is a critical piece of this whole environment, and this is the ecology of the food system. By food system, we're really talking about from seed to table and all the factors that go into choices and influence choices of producers as well as consumers. Next slide. When you put this all together, this is just a good representation of what the ecology looks like. It's this internal health, genetics, biology, and external environment, social determinants, all the things that you'll hear about today. They all get combined to create this ecology. Next slide.

In terms of our goal here, the assessment impact the need. What we need to do is put this all together and funnel it down in a way that'll come out with information that's usable on the ground to the those that are providing care and implementing these programs. Next slide. Next. Just organizationally, Drew mentioned the support that we get from A&D and our partners at A&D. The secretariat for this project consists of NICHD staff and Drew's team, as well as Alison's team at the A&D. As Drew mentioned, without them, none of this happens.

We also had a scientific steering committee in the beginning of this project that really helped inform us in the development of the themes for the working groups and identifying potential participants, et cetera. We're grateful for the support of the scientific steering committee. It consisted of agency representation from both the US and global community. Finally, the bulk of the work here was done by our work which you'll hear from today. Again, I echo Drew's thanks to everybody that was involved in this project. None of this happens without them.

Next line. Putting this all together conceptually, the project was organized as represented by the slides. We had a Working Group 1 that really focused on the biology, that circular Venn diagram in the middle. Working Group 2 is represented in that overarching environment and the external environment. Working Group 3 represented, how do you put this all together and develop some sort of approach to assessment. Working Group 4, which is critical to all the projects that we've done. For those of you that may have seen some of our previous webinars and projects, you recognize that we always try to make sure to have a translation implementation focus.

What are those factors that need to be considered as you translate and implement these projects? We had a tremendous group led by, Dr. [unintelligible 00:12:09] who we'll hear from later. Of course, all this is done across a developmental spectrum that needs to be recognized because there are differences as we go through these different stages. Next slide. This is just a quick cartoon of how we put all this stuff together in an assessment, both in terms of assessment and surveillance. It's not just a matter of documenting the presence of a problem. You really have to have an appreciation of the etiology, and you have to have an appreciation of the functional implications of it.

That's really at the core of what we try to accomplish here. When you have an initial data collection process where you're collecting history, you really need to consider these environmental factors that you'll hear about today. Then there's, of course, the complexity of assessing nutritional status. Then

finally, there's the issue of functionality. These arrows are intended to be bidirectional because there's constant feedback. Patient may present with a problem and you got to figure out what it is, or you may be doing a surveillance to try and figure out, what's going on in a particular group. All these things, they work back and forth in a continuous loop. Next slide.

This is just a brief slide. We'll touch more on this later, but just briefly what we're hoping to do following this project, we are going to publish this. It's going to be published, hopefully in the Journal of Nutrition. The manuscripts are close to being ready for submission. We will disseminate that as broadly through efforts like this. We will attempt to engage the community, not just NIH, but the larger community to figure out how best to address the gaps that we've identified.

We're also going to have a phase II that's really going to figure out how we can take this information and this conceptual approach and implement it in real-world ways in a manner that'll affect the populations we're hoping to serve in terms of the development of evidence-based, equitable, context-specific programs and policies. I think that's the end. Next slide. Yes, it is. Thank you. We're looking forward to hearing from the other working groups. Thank you all for joining us today. We're looking forward to continuing this project and working with you to make sure that we actually can accomplish what we set out to accomplish here and serve these kids that need this help. Thank you.

Connie Weaver

Hello. I had the pleasure of chairing Working Group 1 on the Biology of Nutrient Needs. The next slide shows you the list of individuals in this working group. They were fantastic to work with. We had numerous Zoom meetings over many months and each section was led by one of these people and seconded by another. The next slide shows you the context of the developmental periods. Now, as Dan mentioned, we covered school-age children from age 4 to 19 basically or 5 to 19, but all the working groups agreed on classifying it as pre-puberty, puberty, and post-puberty because the needs are different in those three different periods.

This slide shows you that we understand and discussed that nutritional status and implications begin in utero. There is much that has happened with the different tissues as affected by diet way before you start in school-aged children. If you look at the bottom of this figure, the different categories of development that we considered are listed there with asterisks by what happens with the key periods. For some of these developmental aspects, most has already happened before they enter pre-puberty or school age. Much about the brain has developed, neurodevelopment, for example. You have some final maturing still going on during puberty.

Much of metabolism has already been defined, but you still have some, especially when we concentrate on adiposity, and same with the immune system. Then other stage factors of development still have much to occur during school age. You have the linear and bone growth really taking off in puberty. I'll show you a slide of that, and reproductive health really occurs in post-puberty. Next slide. These are the different sections of the manuscript that we've drafted and the results of our deliberations. We'll go through briefly nutrient needs for growth and development and hit some of the high points that we discussed. Linear growth and body composition, neurodevelopment, physical activity, and immunocompetence and inflammation. Next slide.

For the nutrient needs,, we looked at what the dietary guidelines committee, the last one developed and published in 2021 for how to formally decide what is a nutrient of concern. Nutrients over or under-consumed relative to the requirements by 5% using what we eat in America to make the assessment was the first criteria, but then it had to have an associated biological endpoint with clinical health consequences. They went farther than just what is the gap between intake and recommendations.

There has to be a consequence. For nutrients in the school-age category are shown here that they identified.

All Americans over one year old, including school-aged children, tend to have deficiencies of vitamin D, calcium, potassium, sodium, or excess of sodium and added sugars. All Americans over two years old have concerns with excess consumption of saturated fat and deficiencies in fiber. We considered these nutrients in particular. Next slide, but not only from a national perspective, as in the last slide, we considered global nutrient supply and deficits. Using this model published by Nick Smith out of the Riddet Institute in New Zealand, they used food balance sheets to indicate deficiencies relative to country-weighted targets or recommendations.

This is just a picture of some of the nutrients from the 2018 run of the model and the prediction in 2030 from estimated population growth. The black horizontal bars show you the average with the error bars on it. Calcium, you can see the supply is really short across the globe compared to the requirements in the black bar, and that is also true for vitamin E. It only gets worse as the population grows in 2030. Some of the others are much more modest.

Next slide. Moving to linear growth and development and bone growth, this slide shows you bone mass across the lifespan. Early on birth, there's a great growth spurt, but then during puberty, a really short period of time, you have very narrow but steep growth as children put on adult height and, with it, linear growth. Then you have bone consolidation, but it's only over about two to four years do they put on nearly half of their adult skeleton, and the peak is higher but later in boys relative to girls and the girls are in the decline.

We recognize that growth tempo is really more reflective of the growth process than a single measure of size, but it's the single measure that we have reference values for. We have growth charts on one point of time of height and weight, BMI, but it's the tempo that reflects the process, and we don't have good measures or standards to reflect that, so that's an identified research need.

Next slide. When you look at linear growth during this pubertal period compared to pre-puberty and post-puberty, you can see optimal growth, and if you lack some of these nutrients, you could have suboptimal growth that could carry into adulthood. Listed are many of the nutrients involved with bone as any other living tissue that's needed in developing greater mass. Next slide. Moving to the brain. Much of brain development has already occurred way before the child enters school, but some development still goes on through adolescent growth. That's the executive function where they are able to make more mature decisions and appreciate the consequences that they might have. That development is extremely critical for functioning in society. Next slide.

Nutrients that particularly affect brain development are these macronutrients and a whole list of micronutrients with the main functional relationship to what aspect of brain development they're linked to. Next slide. Here's a conceptual diagram in our manuscript showing how physical activity interfaces with so many other contexts of what the child is going through. A particular focus in this section of the report is the concern that physical activity diminishes over time.

You can see that red line at the bottom and how it lines up across the ages, in particular, that drop at puberty. Next slide. This illustrates more focused way what data show is the drop in total activity on the left, moderate to vigorous activity in the middle, and it's being displaced or replaced with sedentary time. We spend too much time at sitting and in front of our visual devices. Next slide. In terms of metabolism, the focus was on developing of adipose tissue and expansion. Again, in this contextual framework shows all the factors that are internal, external, and the many different types of internal and external factors that influence adipose growth and how that can get out of balance. Next slide.

Each of the sections had a summary of research gaps and future opportunities. We didn't have time to go through them by individual section, but the summary integrating all the different sections are reflected here. Nutrient requirements by developmental stage are going to require improved modeling of individual nutrients and dietary and behavioral patterns for each of the three targeted age groups for better age and sex-specific nutritional recommendations. Biomarkers and bioindicators were a big topic of our concerns. We need better-validated markers in order to really understand how diet affects biological systems and functional outcomes.

What are the long-term consequences? What are the mechanisms involved in these relationships between diet and each of those tissues at the different stages? For example, which tissues can have catch-up growth? If there was a deficiency or an excess early and you adjust it, can we make it up, and which ones we need to focus on? Then lastly, nutrition we must remember is a factor in system science. It's one of the biological variables and we need to consider all of them in concert in school-aged children. Next slide. We handed the baton over to the chair of Working Group 2, Maureen Black.

Maureen Black

Thank you, Connie, very much. I appreciate your talk and your coverage. Thank you very much to all of the people who have tuned in this morning. Very exciting. My name is Maureen Black. I'm from RTI International and the University of Maryland School of Medicine. Our challenge is looking at the nutritional ecology and the gaps in research and nutrition that impact school-aged children and adolescents' functioning. I have no conflicts. Next. We started our mission by developing a framework that would then inform the paper and really guide the paper and guide our approach at looking at the nutrition ecology so that you can see how the nutrition ecology really has a very big impact on children's health and well-being.

The way that we look at this is, the distal environment includes things such as climate, as we know and are confronted with daily, the geopolitical environment, and food systems. They then impact the proximal environment. That includes things that are a little closer to children and adolescents, so it's the community and services offered in the community and schools very much in this age. Then moving from there we have the family and that's where we have dietary intake and knowledge and behavior. Then finally you can see the functional outcomes that include growth and physical and mental health and cognition and socio-emotional and physical activity and school attendance and behavior.

Then the crosscutting issues that we have here includes issues related to nutrition equity, which was a major theme as we move through the nutrition ecology. Of course, we are also considering the child and adolescent development from 5 to 19, and there are major changes as children develop. Then looking at food and water and nutrition security. What I'm going to do is show you an example of the work that we did that is reflected in the paper, but what I'm showing you is really a bite-size. Next.

What this illustrates is the interactions that occur at the levels of nutrition ecology. Those are the two-way arrows that while we may think, for example, that climate is impacting us, "How did we get there?" We impact the climate by our behavior, and the same with the geopolitical that it impacts us but we also impact it. It would be naive to think that this is a unidirectional process and much more likely to understand the bidirectional processes that go on as we consider the nutritional ecology. Next.

This is an example and what we see is in the climate, we're interested in issues such as temperature and the heat that we experience, the cold that also occurs, land use, the water cycles, the biogeochemical cycles, and how that impacts the food system on the yields and the density. Next. Then these are some of the research gaps and recommendations. Again, this is just a bite-sized sample of this. We are looking to models that can predict some of the changes in the nutritional quality of crops that happen related to

climate or some of the health consequences from the diminished grain quality and the populations at risk. Then what solutions do we have to maintain plant and nutrition quality?

Next. This illustrates geopolitical and we can see what's happened is we've had urbanization, we certainly have had population migration. Again, we see that daily and we have conflict and humanitarian emergencies that are impacting us. These impact in the globalization of the food supply. We now have ultra-processed foods that we probably didn't have when some of us were growing up, and we have added sugar and unhealthy fats. Next. Now these are some of the research gaps and recommendations, though we need things like surveillance to identify the humanitarian crises and mobile responses to the humanitarian crises.

We also have gaps related to the other things I mentioned, such as the globalization of the food supply. Next. Under the food systems, the food systems are very complex interacting components related to agriculture and the water and the forest. Then moving from that to the production and storage, and then to the food retail, pricing and marketing, and consumer behavior. It's a very complex system and these clearly are influenced by the geopolitical and climate. Next. Some of the research gaps and recommendations are identifying the leverage points for focusing on nutrition and improving nutrition and identifying modifiable features of the food system that can strengthen or mitigate the impacts of interventions on nutrition.

There are things that one can work on even in these complex systems. Next. In the community, this is where our children live and impacts their daily life. There are policies that can support a healthy lifestyle, such as taxes on sugar-sweetened beverages. Next. The research gaps are to identify the most salient cultural, economic barriers and enablers to children's healthy nutrition within our community. There are many on both sides, barriers, and enablers. To build partnerships with community food providers to determine how to improve the nutrition options so that we are not loading our kids with the excess sugar and fat that Connie mentioned that we know occurs.

Next. What services do we have in our community? These are healthcare and social services and supplemental food. They can have positive impacts on the eligibility and staff and the infrastructure to facilitate referrals. Next. These are the gaps and recommendations. What about doing a better job of integrating nutrition into health systems. Clearly, that is needed. Looking at the economic impact of SNAP, not only on families, but on communities as well, and what would it mean if one were changing SNAP to focus on nutrition security? That's an issue that is currently being debated. These are issues moving forward.

Next. Then, there are the schools. The schools play such a central role for our children and adolescents. Children consume over half of their daily meals and snacks at school. Globally, 50% of school-aged children in 161 countries receive school meals daily. Now, this is really a central issue to consider in the ecology. Next. There are gaps, recommendations, and opportunities. Are there spillover effects, or could there be from schools to households and communities? The World Food Program will demonstrate the benefit on community in providing school meals. How can we improve student participation in healthy school meals? These are issues to examine. Next.

This is the family, and much of what happens at the proximal and distal level, then it's really integrated through the family. The children learn food and eating behaviors, when to eat, what to eat, how much to eat from the practices that they experience in their families.

This is how children develop eating habits and develop autonomy and self-regulation around food and around eating. Next. What we need is to understand that when we look at family dietary patterns, it's not only what they eat, but it's the emotional context of meals. Do you eat under stress or meals under

stress? What the race, ethnicity, and locale, and culture, and socioeconomic status, how that plays into how our families deal with food and deal with meals? Ultimately, to help families provide healthy nutrition that is culturally acceptable to families and that helps children develop self-regulatory behaviors around food and nutrition. Next.

These are the cross-cutting issues that I mentioned, and nutrition equity we considered really the whole way through. These are modifiable factors that are related to some of the social and structural demands and determinants really of health and nutrition. We try to apply those throughout the model. Then the food and water security to ensure that what we have is safe and secure for all children and families globally. Then the developmental component. Next. That if life is quite different for a five-year-old and a 15-year-old, so how these apply to the model that we've looked at. Next.

Some of our conclusions are as we showed that the associations between nutrition ecology and children's health and wellbeing really flow through the community and through the family. You could say they're really mediated through the community and through the family. If we don't consider the nutritional ecology, the risk is that we'll misinterpret the findings of our nutrition programs because they operate within the nutritional ecology. What happens is if we misinterpret things, it'll stall our efforts to achieve nutrition and health equity. This is a concern if not looking at nutritional ecology.

We need to sort out how to scale up evidence-based programs that can improve the nutrition ecology, as well as children's health and well-being. The benefits that they accrue go beyond children to families, and communities, and schools, and to our society. What these takes are multi-level evidence policies that really consider ourselves as a society as a whole and take a broad approach to moving forward. Really it's a widespread benefit for future societies. Next. This is the working group that participated. It was a wonderful group that represented multiple aspects of children's nutrition and development and ecology. Next. This is thanks to Dan and Drew and to Alison and the NICHD and the Academy of Nutrition and Dietetics. Next. Thank you.

Saurabh Mehta

Thank you. We'll switch to Working Group 3. My name is Saurabh Mehta. I'm a professor at Cornell University and I had the pleasure of chairing Working Group 3 focus on assessment. Next slide, please. These are my disclosures. The key one, on a corporate side, is that I'm on the board of directors for VitaScan, a company that is commercializing some of the point-of-care technology partially developed in my research lab. Next slide, please.

I had the pleasure of working with a team of superstars. They're all listed here on this slide. I will also mention them again based on the sections of the working group report. Next slide, please. Just to rearrange everyone, we are right here in the middle of the assessment group. Next slide, please. Our initial mandate was to identify key factors and measurements that can support nutritional and other relevant measures of function and how they might be employed to assess the need for and impact of interventions to design, to provide nutritional support to school-age children.

Next slide, please. Our Working Group 3 report has these sections which align with the Working Group 1 domains that they had identified for what should be measured and what should be assessed. These include physical exam, current approaches to assessing dietary exposure or intake and the nutrient status, linear growth assessment, body composition, physical activity, neurodevelopment, inflammation and immune function, GI health, and also emerging and novel technologies.

Next slide, please. I'll focus on different parts of this flow chart in a minute, but this is just to show you the overall layout of the report. What we tried to report on was on the left, what needs to be measured,

where, who needs to measure it, and how it needs to be measured. We try to frame them from left to right at the bottom in terms of complexity, whether it's terms of resources, training, cost, and so on and so forth, and what the state of evidence is. Then on the top, we went from initial assessment to biomarker assessment, functional assessment, and emerging areas of assessment.

Next slide, please. If we zoom in on the what, what we are looking at is that at an initial assessment, we need to ask ecological or contextual questions about the home and external environment, general health status. There is an option to do a physical exam in certain settings and then dietary intake assessment. Those could be potential parts of initial assessment. Among biomarker assessment, potential nutrient status biomarkers, inflammation, and so on. Metabolic assessment might be another one. From a functional assessment standpoint, the third column here is physical activity and energy expenditure, body composition, neurodevelopment, and cognition, as well as mental health.

Among the emerging or evolving assessment, things like gut microbiome, multi-omic studies, and so on.

Next slide, please. We also tried to categorize them into where these assessments should happen, whether they can happen in a school, can they happen at home, in a field-based setting, or in a clinic.

Next slide, please. Then the third piece was, who needs to do it? What kind of resources are needed, both human and otherwise. Like an initial assessment can potentially be done by school nurse or by clinicians, or can be done by field staff or dietitians. Next slide, please. Then what are the methods that are needed for them?

Can it be done by cautionary-based methods, food records, point-of-care assays, or laboratory assays, or do they need specialized instruments or equipment? Next slide, please. We try to then bend these indicators in this report into four groups. Ones that are already monitored, at least in some settings. Second, that there is a scientific consensus on that we need to measure them, but we need to build capacities or resources to support their implementation.

The third is that there is consensus that we need to measure the domain listed in working group one and two, but we don't have good diagnostic criteria for or validated criteria for use in field or school settings. Then the fourth category was that those that are still emerging with limited evidence on functional relevance, so I'll give you examples on the next few slides. Next slide, please.

Like those already monitored are things like height and weight and these can be routinely collected in schools, for example, on an annual or periodic basis. Next slide, please. Those that there is scientific consensus on, but we need to build capacity or resources or support their implementation are things like height velocity because in absence of maturation data, for example, height velocity is a much better indicator than just height or height change per unit time. Next slide, please.

Then there are other things like we need to build diagnostic criteria or validate for use. Those are things like screening tests for malnutrition, like a strong kits tool, for example. If you are thinking about the assessment of immune function, which markers should be used, and which ones will be sensitive and specific? Next slide, please. Then those that are still emerging with limited evidence on functional relevance include all the multiomics studies, gut microbiome, and things like 3D whole body imaging. Next slide, please.

To make it easier and more accessible, we also try to capture this into a dashboard. This is a work in progress. I'm happy to share the link and we'll welcome any feedback. Next slide, please. What we are trying to do here is that if you look at the top, you can search by any field and you can select a functional domain that are listed in both working group one and our report. These could be like anthropometry and body composition.

Then it will give you what kind of things can be measured, what age group are they most relevant for, or where the state of the evidence is, what their cost is, what feasibility is, what settings can they be measured in school clinics or field settings, and then a listing of what their strengths and weaknesses are. Next slide, please. If I use an example here, next slide, please. If I use an example of Tanner, if I just search Tanner here, then it will show me the domain that it's relevant to its maturation, and what are the things that can be measured within that. Next slide, please.

If you select any of these markers, it will show specific notes about it. Next slide, please. The strengths and limitations, for example, for the same thing. Next slide, please. Now if I put in vitamin, it will show me the domains that it's relevant to its needs to be assessed through dietary intake, biomarkers, and nutrition status. Next slide, please. Next slide, please. Yes, so this is the overall summary of findings that I've tried to capture the potential viable options for programs today that are available today.

For physical exam, intake exam, or tools like strong kits for detecting malnutrition that can be implemented today. For dietary intake assessment, diet quality assessments, or diet quality questionnaires, for example. For nutrient status biomarkers, they're still costly, require training and staff, and require enough time in a program to see any change in those. For linear growth, height velocity seems to be one of the best metrics to quantify short-term changes. For body composition, skinfolds are a viable option, one of the simplest methods that are feasible in schools.

Behavioral assessments for neurodevelopment, for inflammation and immune function, c-reactive protein measurement may be the most affordable and available measurement, but with the caveats of-- it's a kind of a non-specific marker and needs to be paired with other data like clinical outcomes or morbidity data. For other things like GI health, microbiome and so on, it's still in the early phase.

Next slide, please. Several gaps exist, again, in terms of both evidence and then also in terms of resources to implement some of these markers, and those are summarized here. For example, for physical activity, what are the best tools to use in various settings? Body composition, there is an area of feasible techniques, but what can actually be implemented in school settings and so on? Inflammation and immune function.

How do we interpret different cytokine panels or use some of the non-invasive questionnaires or can we use questionnaire-based data to screen for it? And so on, so those are all captured here. Next slide, please. Our report basically described the current state of the evidence, relevance, and feasibility of the current approaches to assessment of dietary intake, nutrient status, and key functional outcomes of importance to the developing school for measuring impact in school children in the US and internationally. Next slide, please.

I will acknowledge the NICHD team, Drew, Dan, and Kimberlea who supported this report, the AND team, Alison and Gabby were invaluable in getting this report to this point. The Connell, my team, Dr. Samantha, you, Dr. Fahim and Jesse have supported this report. Of course, the superstar team that I had the pleasure of working with on working group three. I'm really grateful to them. I'll stop there. Thank you.

Christina Economos

Hi, everyone. My name's Christina Economos. Thank you so much for having me today. I want to thank the organizers and, of course, the team at NICHD, as well as the team at and particularly Mary Raska who supported us throughout this. I'm a professor and the Dean of the Friedman School of Nutrition Science and Policy at Tufts University. Next slide, please. Disclosures, this is my grant funding. I'm Vice

Chair of a Roundtable at the National Academies, and I serve on several advisory boards. Next slide, please.

I want to start by acknowledging the tremendous team we had working on this effort working group for committee members. You can see there were folks nationally and internationally, many involved in intervention trials, dissemination, implementation science, and collectively, I think we came up with a really nice model that brings all of the working group efforts together to show how challenging it is to actually put this into practice. Next slide, please.

Working Group Four was charged with developing a framework for translating and implementing current and emerging evidence to address the need for implementation of context-specific evidence-based programs across the globe, illustrating the factors and levels to be considered when selecting, implementing, and evaluating a nutrition program framework. We also were tasked with articulating principles that would be integral to the implementation and translation framework. Together, I'll show you the framework and the overarching principles that we develop to address these gaps and achieve individual potential for children between 5 and 19 years of age.

Before we start, let me try to bring all of this together with an example. We heard first that there are many different nutrients of concern for young children, and I'll highlight vitamin D as something we know is a problem globally. Vitamin D is a micronutrient and that's soluble vitamin that we get from the food we eat. We're able to produce within the body with sunlight exposure and yet still we have levels of insufficiency and deficiency worldwide. How do we think about getting vitamin D into children and assessing whether or not they're adequate in status?

We talked about ecology and where we can actually work to get specific nutrient frameworks and guidelines incorporated into help children and we can think about schools, so getting vitamin D to children through schools. We can think about how we assess that using a biomarker in some cases, clinical exam, or how they may present physically as possible. In this case, looking at 25-hydroxy D status, for example, would be valuable. How do we really bring that all together?

We can think about using a supplement, and when we think about supplements, they have to be created with bioavailability, they have to be distributed, they have to then be consumed, and the adherence has to be high over time to actually get vitamin D levels higher. That requires a whole team of people at multiple levels throughout the system. If we're thinking about food, we have to think about reformulating products that go into the school system or preparing foods with adequate levels of vitamin D that includes processing storage, then it requires actually serving it to a large group of individuals.

The reach is there and then those individuals actually have to consume it at levels that will actually help. I'm going to show you our framework tries to bring all this together and really spells out the complexity to put a lot of these important nutrition findings into practice. Next slide, please. We used implementation science as really a guide for Working Group Four, and for those of you who aren't familiar with it, it's the study of methods to promote the adoption and integration of evidence-based practices interventions and policies into routine healthcare and public health strategies, for example, schools to improve our impact on population health.

The problem we all have is, we know that interventions happen well in controlled settings, but as soon as you move an intervention out into a public health setting and try to reach a large group of individuals, they're often poorly implemented or not implemented at all, and they don't produce expected health benefits. As an implementation scientist, I've been working in this field for 30 years, and I know that you

can see excellent results when you have control, but as soon as you get it out into the real world, there are many, many, many variables that prevent the optimal implementation. It can be a waste of money, and unfortunately, not produce the effects for children that we're looking for.

IS really seeks to systematically close this gap between what we know and what we do. Think of our framework as actually how we do it, by identifying and addressing barriers that slow or halt the uptake of proven health interventions and evidence-based practices. Next slide, please.

We drew from implementation science, as I mentioned, and I'll just show you a couple of examples so you know what's happening in the field right now. This is the consolidated framework for implementation research, better known as CFIR, and this is really a systems-oriented framework for implementation of research findings or innovations into practice.

It looks at five domains, so you can see individuals, the inner setting, the outer setting, and then it really thinks about the what or the innovation that you're trying to implement, so it might be a particular food that is rich in vitamin D, and then the implementation process. These are a lot of the variables that I'll go through in our framework that, at the end of the day, actually dictate whether or not someone gets the nutrient of concern. Next slide, please.

We also looked at RE-AIM and PRISM. RE-AIM is a framework to guide the planning and evaluation of programs according to five key outcomes, reach, effectiveness, adoption, implementation, and maintenance. These are things we often measure when we're doing the implementation of an intervention. Then PRISM is the practical implementation sustainability model, including key multi-level contextual factors, many of which Maureen spoke about, relevant to program implementation. We use PRISM throughout all stages from planning through sustainment.

Lastly, next slide, we looked at the diffusion of innovation model. This really is important because when you're trying to implement something or a new innovation, it has to be adopted by a lot of people, or a group, or an organization. Within that group or organization, there will be different types of adopters based on their knowledge of and acceptance of new work. That can range from innovators who are typically a fairly small percentage of the population you're trying to reach, who are the first and the most eager to adopt new methods or programs, and then you move to early adopters all the way to the other end of laggards.

We often implement something that's well-intended, even using implementation science, and we only get to the left-hand side of the curve here, which can be about a quarter of the population. Really, the active adoption or that process is really what you need to work on with much of the implementation science so that you move all the way through the curve, and reach goes to 80% to 100% of the population. Knowing that whatever you do is likely to affect a small percentage of people early on, unless you're really using all the variables of implementation science, you can imagine that often we don't see an effect. Next slide, please.

This is our framework, and I want to just take a couple of minutes to try to spell out everything in here and what we need to think about when we're implementing programs. It highlights the implementation indicators that are suitable for use in real-world settings to assess the impact of nutrition programs and policies designed to reach children 5 to 19 years of age. First, I want to focus on the nutrition and food interventions, which are in the purple bar.

This is what I already talked about, implementing meals in school programs or after-school programs, giving snacks that are fortified or enriched with different nutrients, or are low in added sugars, or lower in sodium. We can use supplementation to deliver nutrients. We can use packaged foods, which are

constantly being reformulated and redesigned, and often align in this country with the dietary guidelines. We can think about local and indigenous foods, and then we can think about being nutrition-sensitive. The next level out is really a setting. Where do we do this? As I mentioned, school is an excellent way to implement. There are afterschool programs, summer programs, household and family meals, community programs, hospitals and clinics, workplace, which many children over the age of 15 are working. Then what we call exceptional environments for children who find themselves in foster care, orphanages, refugee camps, et cetera. Then next we're looking at the systems, which Maureen definitely alluded to many of these where we have overarching systems that impact these nutrition and food interventions and the settings in which we implement them.

Those are policy, government, climate change, technology, education, culture, local and regional food environments and marketing. All of these are ultimately going to impact the program and how it's implemented. Next slide, please. Now we're going to turn to what's inside each of these settings when we first think about the nutrition and food interventions. What's important about the actual food or supplement itself? It has to be shelf stable, it has to be high quality, it needs to be produced in quantity, it needs to be inexpensive or context-appropriate in terms of cost-effectiveness and providing a cost-benefit. It often needs to be sustainable, particularly when it comes to shelf life.

Then we look within the settings and these are really the key implementation variables that we think about when we try to implement a program. Are we reaching the number of people that we want? Reflecting back on the diffusion of innovation model we want to get to 80% to 100%, not 25%. Are we providing adequate training for all of the people involved in the setting and even further up into the food system in terms of formulating something? Is it being adopted by a large percentage of people? Is it actually being implemented as designed in terms of fidelity? Is it being distributed appropriately? Is there capacity building in the setting so this can be continued over time, and is it being distributed with equity in mind?

There are many principles of equity that we brought into this framework and are explained in the paper so that we don't just reach a group that's easy to reach, but we're thinking about equitable distribution of nutrition programs. Then of course, at the top, as I mentioned, diffusion of innovation, thinking about the economic landscape, the conditions for scale and sustainability, and the political will depending on where you're working. Next slide, please.

Just to wrap up, we had overarching principles that we believe are integral to the implementation and translation framework that we developed. The first is that intervention design must purposely target developmental stages. As was mentioned already, children at the age of 5 are very different than children at the age of 18 or 19. We need to use transdisciplinary science to facilitate collaboration and consider everything you've heard about today. Equitable engagement of diverse stakeholders is required to foster inclusion, develop relationships, build buy-in, and really co-create customization of the interventions. We have to consider the range of contextual drivers including social, political, racial, historical and economic impact that influence these programs, policies, interventions, and procedures developed in one setting may not be applicable to another, which is really why context-specific is emphasized throughout our paper and really talking to people in settings and learning about the lived experience is critical.

Building for sustainability really does include economic and financial analysis, making sure that appropriate fit within existing systems and flexible adaptation is occurring. Next slide, please.

Last but not least, there are lots of partnerships that are required for effective collaborations. This is really a detailed way of saying people implement. We can put anything we want on paper, but unless you get the right people who are implementing using implementation science, we won't see the impact of important evidence-based programming. Next slide, please.

Thank you.

Daniel Raiten

If I could just for a minute I'd be remiss if I didn't mention some of our other partners here, and I should have mentioned this earlier, but I want to make sure to mention it now. This project started as a result of conversations amongst several groups. Those groups included the World Food Program led by Carmen Burbano who is the leads the School Meal Coalition, which is a coalition of I think almost 90 countries at this point at the World Food Program.

Diane De Bernardo, who is my co-chair on the epic subgroup [unintelligible 01:05:08] subgroup, and also works at the USDA Foreign Ag Service on the McGovern dole program. Diane has not only been a staunch advocate for this project but has supported it in many ways and we're grateful for her partnership. Lastly is Dr. Donald Bundy at the London School of Hygiene and Tropical Medicine, who is been a champion for school meals and nutrition for school-aged children for many years. He currently leads a Research Consortium at the London School under the aegis of the school meal coalition, so I just wanted to make sure they acknowledge that.

As you've seen by these presentations, it's been a tremendous amount of work, but now we need to, as Christine just highlighted, we need to get it to the people and figure out what to do with it. We are now going to move on to a panel, and we're very happy to have my partner Alison Steiber, the moderator, thank you.

Alison Steiber

Great. Thanks so much, Dan. I would like to ask our panel members to please turn on their camera, if they can, and unmute and we'll begin the discussion. Our goal here today is really to think about those individuals who will take all this great work, particularly that last piece you heard about translation, and think about themselves as end users of this information, and how do we take this and translate it into actionable items. We have a couple of questions for the panel. I think it's okay perhaps not to pin me, but to take, stop sharing the screen and just open it up to the panel so we can see everybody's faces would be great.

I'm going to throw out the first question, and what I love to have happen is, if any one of our panel members could respond, and before they begin to respond to the question, you can introduce yourselves, that would be terrific. The first question is what is the value of what you've heard to your agency's efforts to address the nutritional health needs of school-aged children? If one of my panel members wants to take a stab at that, we can begin the discussion.

Prerna Banati

Alison, I can take that. This is Prerna.

Alison Steiber

Great. Thanks so much.

Prerna Banati

Hi. Hello. Good morning. Good afternoon. Good evening, everyone. My name is Prerna Banati. I am in the WHO Department of Maternal Newborn Child and Adolescent Health and Aging. I am a research scientist in our adolescent and young adult health team. Thanks so much for this really tremendous body of work that you've shared, that all the coaches have shared, and really under Dan's leadership, I can see a huge amount of time and investment in some really, really important thinking, so thank you so much for that.

I think for us, just looking at the work that we've done at WHO and the work that we're building forward, I can see a couple of places where what you've presented today, what I've heard today, what I've learned today can really interface three practical areas, and I'll give you very quickly just in the interest of time recognizing that others may also wish to come in.

The first one is around school health services. I think we've heard about school health services. WHO has a guideline for support to policymakers and practitioners in the field around the implementation of comprehensive school health services. That includes health promotion, nutrition, education, it includes micronutrient supplementation, the entire comprehensive set of interventions for school health and nutrition. I think this is a really important area of work that can help us inform and better provide the support that policymakers and practitioners can use through our guidelines.

The second one is we're building areas, an area of work around well-child visits, so looking across the life course from childhood through adolescence, what are those touch points where health checkups can be best used to identify and diagnose conditions, to seek referrals, to share health information, and what do those moments look like? What kind of information can we provide meaningful use to adolescents and young or young children? What screening tools do we need at what ages? That kind of thinking really can be informed also by your work.

Then lastly, I think also we're growing our portfolio thinking a little bit more about climate change and the impacts of climate change on health we're about to look at particularly heat stress, heat and heat stress, and the impacts on health, and clearly nutrition and has it's a huge and a big influence in that relationship, so thinking more and unpacking that more concretely, I think, would be very useful for our work going forward. Thank you so much. I'll hand back to Alison.

Alison Steiber

Great. Robert, Chika, Yibo, do you want to add something to that?

Chika Mayashi

Sure. I can maybe just add a few points. First of all, I had the privilege to join some of the meetings earlier on, maybe two years ago. I just want to say first a tremendous things and the huge effort the team has put together because when I joined the first meeting, I just thought it was very ambitious, but really all the working groups put so much effort to really turn things around and share their findings, so thanks for that.

On UNICEF, one thing I wanted to maybe share with everybody is once a year we have something called the Global Nutrition Network meeting, where we bring together all of our advisors from all of our regional offices to really talk about what it is that we want to do. This year, it's a three-day meeting, but two of the three-day meetings will be devoted to school-age and adolescent nutrition because it is a top priority and an area we really want to move the needle on.

I think a lot of the work that was presented today will really help because I think it really works on some of-- I think Dan used the word biological, but I think it's really some of the foundational evidence to look at the details of what is it in nutrition and how does that link to cognitive function and physical function, but also really the environment which really resonates with UNICEF's thinking around moving things forward using the systems approach. There's a lot of details in that, but we really appreciate the effort and I think there's a lot to learn from.

The one thing I did want to raise is, I actually work in the data division. I'm responsible for nutrition data, and one of the gaps we recognize is that there's no global monitoring framework on school-age and adolescent nutrition, and it's something we're working on. I think a lot of the work here would inform our initial draft framework we'll develop this year. I think your future work as well will provide evidence as we periodically update that framework when we get more evidence on what it is that we should be measuring and what it is that we can measure. I have a lot of other comments on operations research and stuff, but I'll save that for later. Thanks.

Alison Steiber

Great. Well, Robert, do you want to add to this?

Robert Akparibo

Yes. Thank you very much and I'm really pleased to see the attendance, especially people from the African region have really joined. I think we did circulate the information around and I can see that a lot of people from Africa joined the webinar, which is really good. We are planning that you will replicate this presentation to focusing on the African audience because I believe that phase two is going to take place in Africa, and so beginning to engage with the African audience would be the right way to go. I think my two colleagues have already mentioned that your work is going to be a foundation for us to build on. I think the main issue for us is the fact that the nutrition issues of school-aged children and adolescents are often overlooked. Because of this, we do not know the real nutritional challenges or problems of this age group. I mean, when Saba, I don't know whether I've mentioned your name well or not. You did mention that there are currently challenges in terms of standardized indicators for measuring the nutritional status of children.

Of course, this is just the main thing that you're doing all this work, but then because of the different cut-offs that we have, the WHO have their own cut-offs. The IOFT have their own cut-offs, and there are different age groups, so it makes it very difficult for us to use the current indicators to be able to assess the nutritional status of children. Also, the second concern is that currently no also standardized indicators for evaluating the dietary diversity of school-age children and adolescents.

Of course, someone mentioned dietary exposures. All these are challenges that we need to as a group of professionals begin to think about how do we address them and this is what the research consortium is beginning to engage with the World Food Programme. I'm glad that the World Food Programme has been part of this process. The World Food Programme is leading the process of creating a database school meals and within that database would've had indicators that can be used to measure nutritional status of this age group as well as looking at their dietary diversity and dietary exposures.

These are some of the things that we have been discussion. We have been engaging with nutrition networks, one of them the African Nutri Society because we want to start from the African continent and see how we can look at it because, Chika, you just talked about having a global monitoring framework. We need also a global database for school meals and this is what we have been discussing within the last three months to see how we can address that problem. Thank you.

Alison Steiber

Those are really excellent points. They really transition into one of the questions we got in the question and answer box. That was how to take care of the nutritional needs of three different developmental groups. They were looking at 5 to 9, 10 to 14, and 15 through 19, all within a school environment and all receiving the same meals. I don't know if anyone wants to address that, but it, I think if you're going to create a framework and you're going to create a data monitoring and evaluation repository, you need to be able to address how to measure that in a valid and reliable way. I don't know, Saurabh, if you want to touch on that for a second or if anyone else wants to—

Daniel Raiten

Alison, did you want to give Yibo a chance to respond?

Alison Steiber

Sure. Oh, Yibo, you're mute, I think, still.

Yibo Wood

Hear me? I'm a senior—

Alison Steiber

Do you want to try one more time so we can hear you?

Yibo Wood

Yes, can you hear me? I can hear you.

Alison Steiber

Yes. We can now hear.

Daniel Raiten

Yes, we can hear you.

Yibo Wood

Great. Great. Sorry about that. Yibo Wood, I'm a senior nutritionist for work at the Food and Nutrition Service at USDA. It's a domestic agency, manage 15, now 16 nutrition assistance programs. I'm also part of the Global Nutrition Coordination Plan community. As I listen to and I also look in the Q&A box. Just a few reflections on the programs we operate at our federal level from the four different groups that we talked about.

I think from the nutrient needs in the first group that the presentation, my reflection is we have very science-based standards for supplemental foods for our WIC program, which target the infant to age to five as well as pregnant mom and postpartum mothers and lactating mothers, and I think that's a very important group and a lot of surveillance studies.

Research studies show WIC works. I also think about, then the school-age children. We have national school lunch program, breakfast program, childcare programs targeting the group about 5 to 19.

Again, the nutrition standards for school meals are science-based, and I think these are the key elements of the science directs the policy and the program design and implementation. Then if you look at the IT guidelines development process, many of you may be familiar USDN and HHS are working together. It's very science-based, and I heard the system science approach, I think [unintelligible 01:18:57] looking at the system science approach now in the current development of the dietary guidelines. From the second group, I think it's really important to look at ecology.

I just reflect on so many different factors. I think with our school children, part of the school lunch program, we have team nutrition, which is a program that apply for all kinds of strategies to educate not only students, but the teachers, the parents and the community. It's all part of the strategy grants

supporting these efforts to support our community. Some of you can look at some of the examples, and I think besides the school meals, we have snacks program.

In recent years, we have also established stand nutrition standards for snacks serving schools outside of school meals during the school day. Then the school wellness policy is another two that Congress mandated for communities to be engaged to support a holistic approach to support.

For the assessment I think we are fortunate to have a very comprehensive enhanced studies here in the US. Collect data. There's mobile clinic goes out, collect information, and so we are able to extract the information to compare the program participants and non-participants. The recent HEI, the Healthy Eating Index, have been published for the first time reflective of toddlers age group. For implementation and translation, again, I think it's so important for all things together and the partnership certainly is a key for our work. We work with partners all over the spectrum of the participants that we reach hopefully for the ultimate goal of improving the healthy eating for all Americans.

Alison Steiber

Perfect. Thank you. That was great to also thread in a little bit of the US context. I think, though, regardless of what area you are in, addressing the nutrition assessment of these disparate age groups is going to be a challenge for people running school meal programs. I wonder if we could talk just a little bit more in our remaining time. We have about four minutes, but Saurabh do you want to address that briefly or direct people to thoughts on that?

Saurabh Mehta

Sure. I'm not sure I have an answer for that, but I think a key element as others have alluded to, I think is also data systems. I think that's a big gap for these, if we have data systems that can work in low connectivity and are more accessible, and in those contexts, I think that will help because we do have the computational power and that might be more. My personal viewpoint here, not NI or anyone else is that I think if you can make those accessible, and that might be a bigger driver of some of these democratization of some of these processes, because I think that can make things more accessible and affordable and for monitoring as well as for other purposes.

Alison Steiber

Great. I think that I'm going to turn it over to Dan to make concluding remarks, but I just want to thank everyone for the great information and you'll hear lots more about this. As Dan alluded to, there will be a supplement that's coming out with manuscripts that will dive much deeper into these topics, so we look forward to sharing with the community a lot more. Dan?

Daniel Raiten

Thanks Alison, and thanks to the panel for your thoughtful thoughts and very valuable and we'll use those moving forward to the next phase. We are engaged with a number of entities represented on the panel and elsewhere to move forward into Phase 2. I will just briefly comment about the issue of climate. This is an important issue. It affects everything that we're doing.

We do have a number of efforts. USDA is now initiating a process to determine the process for how to integrate questions around sustainability into the development of future iterations of the dietary guidelines. This is an ongoing effort. We also have a project that you'll hear more about in the coming months, through this working group, GNCP, and another working group called Climate Health Agriculture and Nutrition, the Global Ecology, the Change Group, climate was identified as a high-priority for the GNCP.

In this current iteration GNCP, we have a project called Advantage that's really focusing on the evidence around the core issues that we need to explore to address the intersection of climate, food systems, nutrition and health. It's organized in a similar way to bond kids. We have working groups already developed. In this case, it'll be five working groups. What's relevant to this is that one of the working groups is really going to be focusing on the analytical frameworks.

How do you take this complex set of issues that we heard about here today, and certainly in the context of that intersection with climate? How do you take that and integrate that in both in terms of the science development of protocols for addressing that intersection as well as as surveillance?

Currently, we don't include climate. Much of the surveillance that we use, like Yibo mentioned and Hanes, and other things that are out there, the demographic and health survey, DHS surveys that are done globally, they currently do not integrate consideration of climate, and how do you do that? What are the measures? What are the indicators that you're going to use? How do you measure it, and how do you analyze it? Stay tuned.

We're at our time's end. I want to thank all the participants for tremendously valuable session. You can all see how grateful we are to have had this group together, they've done a tremendous amount of work and we'll get this out to you and the community as soon as we can. I want to thank everybody that joined us today for the webinar. Your input and involvement is gratifying and really reinforces the notion that this is a really critical area and we look forward to working with all of you moving forward. With that, unless anybody has anything else they want to add, we will end the session and look forward to meeting with you again in the future.



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