

Webinar Series: The Role of Diet in Early Child Development: Evidence from Nepal

Webinar Transcript

Katie Heneveld

Morning, afternoon and evening. Thank you all for joining today's webinar to learn more about the role of diet in early child development. My name is Katie Heneveld, and I'm an assistant researcher for the Feed the Future Innovation Lab for Nutrition, and I will be your MC for this webinar today. As attendees are joining, I'll begin by going over some housekeeping items. I'd like to direct all attendees to a few functions on this zoom webinar. At the bottom of your screen, you should see a chat icon and the Q&A icon. Use the chat feature to engage in relevant conversation with other attendees. If you have a question for one of the panelists, please use the Q&A feature. Panelists will respond to questions in the Q&A box throughout the webinar, and we've allotted the final 20 minutes of this webinar for Q&A. If you are experiencing any technical difficulties, please send a message in the chat box, to "All Panelists" so that our technical support staff can work with you to resolve them. This webinar is being recorded and will be made available on the Innovation Lab for Nutrition website and the USAID Advancing Nutrition website. There you can also register for upcoming webinars and view recordings and slide decks of previous webinars. We will repeat these technical housekeeping items in the chat throughout the webinar, as people may join at later time. I'd like to begin by introducing Dr. Patrick Webb who's the Director of the Innovation Lab for Nutrition and the Alexander MacFarlane Professor of Nutrition at the Friedman School of Nutrition, Science and Policy. He'll provide a brief description of the nutrition innovation lab before introducing the moderator for today's webinar. Dr. Webb, over to you.

Patrick Webb

Thank you, Katie, and hello, and welcome everyone from all over the world. I see people joining from Peru through Afghanistan to (inaudible), Nepal, Zambia, Puerto Rico, and beyond. So you're all more than welcome. And this is a great way to share and have dialogue with people in the field all over the world. So I'm Director of the Nutrition Innovation Lab, and we've all been looking very much forward to this second round, second season of webinars, myself very much included, anticipating the sharing of findings, rigorous empirical evidence from field research, primarily in Sub-Saharan Africa and South Asia, but often in other countries as well. On a range of topics that cover the entire pathway from agriculture through income and diets and time allocation, health seeking behavior to nutrition and health outcomes. Very important to be able to support, improve program designs and policy options, especially for USAID, but also for national governments organizations around the world. So these are just a few of the partners, a few of the types of studies that have been engaging over the past decade or so, with us in the

adventures that you are going to hear about through this second series of webinars. Today we're kicking off with a quite specific focus on child development and its relationship to diets and early childhood development. We have some amazing speakers who've spent so much time in the field and to facilitate these presentations and discussions we have, with great pleasure, Dr. Irwin Rosenberg with us, who's Professor Emeritus in nutrition and medicine at Tufts University. He was a Director of the Human Nutrition Research Center on Aging, as well as Dean of the Friedman School of Nutrition, Science, and Policy. And throughout his eminent and long career, Irwin has participated in so many important activities, supporting committees and for the food and drug administration. He was chair of the Institute of medicines, food, nutrition board, for example, and I've learned so much from engaging and being mentored by Irwin over so many years in his own research. He's continuing to be engaged in research, particularly on the impact of diet and nutrition on aging brains, like mine, with specific reference to vitamins like nutrients, like folic acid and B12. So with that, I will hand over to Professor Rosenberg to carry us through this important webinar. Thank you, Irwin.

Irwin Rosenberg

Thank you. Thank you very much Patrick Webb, and I want to start by congratulating you and the team on so much important progress with the innovation lab. The concentration today looks upon the fact that good nutrition is critical, maybe not sufficient for early childhood development and that development has multiple facets, including social, cognitive, emotional and physical development. And we hope, in this webinar, to explore the relationship of household child factors, including diet quality consumption of animal source foods, anthropometry to the early development of children focusing on the Nepali population. And we have a remarkable group of participants who are not only expert in the field of child development, but who share an in-depth focus on the problem as it's being studied, particularly in Nepal. Dr Andrew Thorn Lyman is associate scientist and nutritional epidemiologist in the center for human nutrition at John Hopkins Bloomberg school of public health. And he will be talking about research links between food systems, diets, nutrition, and health outcomes, and the development and validation of indicators to measure that effectiveness. Dr. Laurie Miller is a Professor of Pediatrics at Tufts University School of Medicine, Adjunct Professor in Nutrition at the Friedman School of Nutrition, Science, and Policy and Adjunct of child development in the Tufts Elliot Pearson, the department of child studying human development with support from USAID and then Mission Innovation Lab. She has worked with Heifer in Nepal since 2009 to assess health nutritional status and development of children. And she will be exploring some of those important findings in a few minutes. We're pleased to have Dr. Merina Shrestha, an associate professor in the department of pediatrics at Tribhuvan University, teaching hospital in Katmandu in Nepal, and her interests include child development and disabilities in particular. I think Dr. Shrestha will explore with us the methodology that she has pioneered in, an ages and stages questionnaire to assess child development. And our fourth speaker will be Dr. Shivani Ghosh who's a Research Associate Professor at Friedman School of Nutrition, Science and Policy at Tufts, and she is the Associate Director of this very productive Innovation Lab. Her research interests are in understanding the role of agriculture in improving nutrition, while ensuring health, assessing the diet and non-diet determinants, and nutritional status. And we'll be particularly focusing on some of the work with animal source foods. So, I think we can now proceed to these presentations and let me call upon Dr. Andrew Thorn Lyman.

Andrew Thorne Lyman

Thank you so much. And thank you all for attending. What great attendance we have from all over the world. It's thrilling to see all of these countries and people introducing themselves at the bottom of the screen.

Could you please turn to the next slide?

So I think that many of you are probably from the nutrition community, but perhaps from the agriculture community. And wow. I think one of the great things about nutrition as a field is that we're all kind of used to systems thinking, you know, because nutrition is influenced by so many different things, by food systems, by what's available, by culture, by so many different things, by water and sanitation. We're used to thinking across fields. And I think this gives us, it makes us inherently interested in trying to create bridges with other fields. And so today I'm going to be talking about the rationale behind why we were thinking about child development and wanting to do some research overlapping and bridging, you know, this field of nutrition with child development within our field of nutrition thinking, especially from the standpoint of nutrition programs, I know that many countries have had stunting sort of over the past 10 years. There's been a lot of interest in stunting as an indicator, and stunting has really been front and center of what we're trying to change in many programs. But I think increasingly people are realizing that stunting can be difficult to change, and it doesn't move very quickly. It's a great proxy indicator for poverty, it's correlated with poverty. Traditionally actually in the child development field as well. Originally, if you look back at the original Lancet series on child development, I think stunting was also used as a proxy for estimating the number of children, you know, who were at risk of developmental delays. And that's because poverty is also a good predictor of child development. Now we know that stunting is still useful, you know, it's correlated with women's rights, which is a risk factor for adverse birth outcomes. And it is a proxy for what the former world bank president Jim Yong Kim called "gray matter infrastructure", you know, the development of nations, but it's an imperfect indicator. And so the rationale for starting off this work, which we started probably about eight years ago, what we were thinking about was: what if you could measure child development directly in some of these very rural agricultural settings? And at that time, there were a few indicators that were really suited for that. Next slide, please.

So this is a framework that I like very much. It's a framework from a manuscript by Beth Prato and colleagues at UC Davis and others, some other colleagues from all over the world. Actually, this was in three settings guide in Malawi and Burkina Faso and they were trying to sort of operationalize: how do, you know, when we say that child development is influenced by poverty, what are the different potential pathways that might be influencing (inaudible)? And so we have on the left environment, and sort of the interactions between poverty, maternal education in particular, water and sanitation, and all of the environmental factors, which influence both the factor, both the context that women, mothers in particular have, since they're the main caregivers, in many countries of children, that caregiving things like responsive feeding in particular, stimulation are extremely important, and these are influenced by poverty and all of these sort of combined to form the environment that influences children. And so I've put feeding there in blue, because I think it requires emphasis because feeding can be many different things. It can include the dietary quality, the foods that are fed to children, the diversity of foods, the nutrients that are in those foods, how often children are fed. The stimulation that goes along with, you know, with the feeding process, so many different things. And so it really requires, I think, you kind of have to expand that all up into many different aspects of the feeding. This is basically a framework that I think is very useful and something that we've used, that's influenced our thinking as well in

designing these studies. Next slide please. And so the rationale for our work in Nepal, you know, when we first started, it was just that there were very few studies done looking at the relationships between environmental factors, especially those related to agriculture and nutrition and child development. There were lots of studies looking at dietary quality and stunting or child growth, really just one or two studies from low and middle income countries, looking at associations between dietary equality and children's development indicators, the access to field friendly tools. And so, you know, we helped to, as Dr. Shrestha will talk about in a second, you know, we work to try to modify this tool to make it appropriate to use within a large scale survey. So a broader nutrition agriculture survey, because we were able to sort of modify this to make it more field friendly that opened up the possibility then of exploring relationships outside of the urban and peri-urban areas that we were applying it to before. And so basically three main questions here that we sought to answer. And one was just, could we, was it feasible to integrate, you know, this tool and operationalize it within these broader assessments? Were the relationships that we observed strong enough to even be captured with this tool? And with the dietary diversity indicators that we were using, we didn't know whether or not these relationships would be strong enough to detect. And then third, what relationships, what other relationships are important in terms of influencing child development in some of these very rural contexts? And so that's the rationale for our work. Next slide please.

And I'd also just like to say thank you to this very broad team of collaborators and to the USA nutrition, Innovation Lab for funding this work. This has been truly sort of a collaboration across fields between our colleagues at the Institute of Medicine at Tribhuvan University in Nepal, IFPRI, Heifer International and also several fantastic colleagues from Norway, child development experts, as well as Dr. Wafaie Fawzi at Harvard School of Public Health. And so now I'm going to pass the baton over to Dr. Merina Shrestha. We'll talk about the ages and stages questionnaire and how it was applied.

Merina Shrestha

Thank you, Andrew. And Andrew has told nicely, we are what we eat. Don't we? It's very exciting to see many people from diverse community, diverse culture, and it would be very wonderful to discuss what we are doing here in Nepal. And I think it would be helpful for everyone. And I have tried to make these slides as simple as possible. As we talk about child development, we all know that it is one of the basic science of child care, without including child development in healthcare, it will be incomplete. And when we talk about child development, there is a biological, psychological, emotional genius going on all of the time. It's a continuous process and it is strong, the complete dependency of early infancy to complete on autonomy when we become adults. And we all know that the development of a child is a continuous process. It has a similar sequence wherever you are, whether you are in the US, whether you are in Africa, or whether you are in Peru or Nepal, the course of development is the same, but the rate of development, life value, depending upon the stimulation, the food you got. So for each child, the complete health assessment is incomplete without assessment of child development. So next slide please.

So when we talk about, there are two terminologies, like growth and development. And when we talk about growth, if the increase in size of the number of neurons and increase in the size of the brain. For a child, when the child is just born, the brain size is around 400 grams. And when the child grows at around one year, it will be around 1000 grams, and by two years, it will be 80% of the adult size. And by 18 years, it can be around 1400 grams. So then there's this increase in the

size, we call it growth. However, the development is the maturity of the function of the brain. That is what we call it development. So it's very easy to assess the growth of the child. So for growth, we do measure weight, we do measure height, we do measure head circumference, and it is very easy to perform those assessments. However, when you talk about development, it's little bit tricky and a difficult assessment, because it's not directly visible with our eyes, and we need to have some assessment tools to assess the development. And for this development of the child, we use different development or assessment tools. Few of the tools are self-reported tools, used by the parents or child keepers whereas some are used by experts. For example, here, we can see tools like PEDS, M-CHAT or ASQ, which can be self-reported tools that can be used by the parents, whereas the most standard tools for child development, babies, infant development for this very trained psychologist actually assists the child with the use of tools. And along these tools, as I've already told Bayley being the gold standard, it requires a lot of time to assess a child. It might take around 45 minutes, almost 90 minutes to assess a single child, and others are the range reported question. We must take that much of time and among these tools are the topic more about the ages and stages questionnaire, we have been using this questionnaire in our researches. Next question, next slide, please.

In developing countries, the reason a publication has now more focus on child development, and we all know that almost 5 million children in low and middle income countries are not reaching to their potential. And in Nepal itself, there was a study published in 2016, which has shown that around 40% of children between 3 to 4 years are not attaining their optimal development. And we are now, I'm very happy that people are now prioritizing child development. And imagine Academy pediatricians have also recommended that being developmental screening should be done in the well maybe needed, especially at 9 months, 18 months or (...). Next slide please. Coming to ages and stages questionnaire. So this ages and stages questionnaire is now attaining lots of attention. And it has, I mentioned that because the project will become a global developmental screening tool. And it's already being translated in 23 different languages. And it has been used in diverse cultural settings. The ages and stages questionnaire has 21 questionnaire sets and for different age groups starting from two months to 60 months, we can, by using this questionnaire, we can use that to assess the development of this wide range of children. And this questionnaire is very easy and they can be filled up by the parents or caregivers who are at the education level of four to six standard level. It can be used by the professionals in their busy schedules, busy outpatient department, as well as it can be used in collaboration of the professionals with the parents and the caregivers. Next slide please.

So actually what is the ages and stages questionnaire test? So when we talk about this, this questionnaire actually tests five different domains of the child development. When talking to communication, it can test their receptive language, as well as the expressive language. How much the child understands and how does the child express through language and sometimes with gestures? And the gross motor is how the child is using the large muscles. Gross motor will be telling us whether the child is able to sit on time, whether the child is able to walk on time, or run on time. Similar, the fine motor is the function of the small muscles of the hand. Whether the child is able to pick up the small objects, whether the child is able to write, make circles, so this comes under fine motor. Even eating, using spoons, that comes under the fine motor domain. And coming to the problem solving, when we talk about problem solving, it's the child's ability to understand and solve problems, and it could be a different function and abstract thinking. And when we talk about the personal and social domains, it's how the child interacts with the

environment, the parents, and how the child interacts with unfamiliar people. So this comes under the personnel and social domain of a child. Next slide, please.

Actually this ages and stages questionnaire is developed in the USA. And when we use this ASQ in our local context, Nepalese context, how we use it, first of all, we translate it in Nepali. And then we translate back the same questionnaire in English and adapt that after many field trials. And there are a few items that we need to adapt in our situation, especially in our context. Most of the tools that are suggested by the ASQ itself are very simple tools, however, tools like stroller. So in Nepalese context, strollers are very expensive and most of the children have not seen those kinds of strollers for assessment. So we made our own strollers. If you can see in this picture, we made a wheel out of the wood. So there is a wooden bar and wheel, and the child can stroll, eat, and we can assess while the child is playing with these kind of tools. These are the simple wooden glass, and this is a doll. So with the use of these tools, we assess the children. Next slide please.

So this ages and stages questionnaire is being used in our Nepalese site since last 2014 in different nutrition studies. One of the study sites is in Bhaktapur. That is just near 20 kilometer from Kathmandu. And another site is a big site. If you see the bigger circle there, there are four sites, Bardia, (inaudible) and this is the site where Laurie, Andrew and the groups use ASQ for assessing child development in the field site. And Bhaktapur is another site where I've been working to assess child development for a long time. We've been using ASQ starting from 6 months to 60 months. Next slide please.

Before we go to the research site, what we did is after we use our fieldworkers, we trained our fieldworkers to use this ages and stages questionnaires on the children in their homes. And before we went to the research side, there is a lot of discussion on ASQ questionnaire. There's hands on training of all the field workers and we also did lots of standardizing exercises. And when we got the very satisfactory and the classical relation only then we went to the research site. Next slide please.

So these are the pictures showing how we have done this questionnaire assessment. And this is in those clinical sites, it's in our research lab, in Bhaktapur. And so this is a very standard, optimal place where we did the assessment and been using ASQ. You can clearly see how they are playing and at the same time we're assessing them. Next slide, please.

And in this picture, if you look at the lower picture, there are some roof and these are the tented roofs. It's immediately after the big earthquake in Katmandu in 2015. But we could do the ASQ assessment at home by the fieldworkers. And if you see in these pictures, there's one person behind that the person is bicycling and it's in the courtyard, open courtyard. It's a quiet courtyard. And the field worker was able to assess the children. This is a 6 month old child, and she is assessing that. In the picture below, down below, we can clearly see there is the grandmother and just behind is a grandfather. And both the grandparents are totally involved while the field worker was assessing the child. And it was one of the very nice picture to see, it always brings a smile to my face. Next picture, please.

This is from Bardia and back inside. This is a field picture. It's a little bit different. If you look at the picture from Bhaktapur site to the Bardia site, these are all the assessment being done. Other things there, but there are many people who are observing other children, and there are other bigger child when small child is being assessed. So it's challenging while we assess the children at field site using ASQ, but it is possible. Next slide please.

So the challenge is respond while using this ages and stages questionnaire, especially when we assessed the younger children, because as I already told you, there are very wide ranges of

children, and the questionnaire is also wide range and there they're very small, very subtle nuances in these questions.

Like simply picking up an object with the use of how many finger or fingers and holding the object without support on the palm or with support. These are very little nuances between the ages and sometimes it's really challenging for one to observe it very carefully. And the wide range of questionnaires like, sometimes if one child is 6 months old. And the next day, if you have to assess a child who is 5 years old, the questionnaire is quite varied. And sometimes that makes a little bit difficult, especially for the fieldworkers. And training and quality control itself is another challenge and training with standardization. It's very easy, but even with the continuous research, we need to do quality control in between by scoring the same child, which is possible, but still it is one of the challenges during the research itself. Next slide please. But there are more than challenges. There are more opportunities than the challenges. So the important thing is that the ages and stages questionnaire is very simple, easily understandable, and you don't need very highly skilled manpower, even a person who can read and write can be trained to ASQ, and this is less time consuming. For a child using this ASQ, it takes around 15 to 20 minutes, whereas I've already been like four Bailey takes sometimes 90 minutes and it's locally available too. We can easily use this ASQ and it's very easy to administer and observe. For the larger scale studies in field site ASQ can be a good option for the sheds. And this is very short on ASQ. And I would like to hand over my virtual floor to Laurie. And before I say bye, these are few pictures, ... back please. Yes. And this is the Bhaktapur site. This is the world heritage site and the part, the animals, the striped tiger and the one horn rhino these are from Baky and Bardia. And here I would like to welcome you all to visit our research site and enjoy these views. Thank you.

Laurie Miller

Well, thank you Merina for that excellent talk. And also for the mini vacation in Nepal, we, I think we all could use that. And it's my pleasure to be here with you all this afternoon, this morning, this evening, and present some of our work on diet quality over time and how it might be associated with better development in young, rural Nepali children. Next slide.

As you heard from Andrew, the associations between child diet and developmental status in resource-poor settings remain incompletely understood. Moreover, these relationships are seldom examined longitudinally. Next slide.

We developed four research questions with some of the framework that he presented to you in mind. First, is diet quality associated with better child development in young, rural Nepali children? Second, what is the nature of these relationships in early childhood? Third, which other household factors might be important in these relationships? And finally, are there age related differences in these relationships? Next slide.

We were unable to embed our longitudinal study of child development within an ongoing existing community development intervention trial that was taking place in Banke and the Western part of Nepal that was implemented by Heifer Nepal. And I hasten to add that this intervention trial had absolutely nothing to do with child development. You can see the format for this trial. It was a study conducted over 48 months with six household visits to about 974 households. Next slide.

Here you see the information that we collected at these six visits indicated by the arrows at the top of the slide. At each visit, we collected household demographics, child anthropometry, and diet recall. At the midline survey round three and the endline survey round six, we also collected

developmental information using the ages and stages questionnaire that Merina just described to you. At the last visit, we also collected a set of information regarding home child-rearing quality based on the multiple indicator cluster survey developed by UNICEF and validated for Nepal.

Next slide.

Thus we ended up with two groups of children who had developmental testing results. The first group, the midline group, who had been tested at the age of 23 to 38 months, a very narrow age range. As at that time, we were actually trying to see if we could optimize this methodology for field work. And then at endline, a group of 23 to 66 months, the upper limit for the ages and stages questionnaire. Next.

Our first research question was whether diet related to child development in young, rural Nepali children. Next slide.

I want to first give you a bit of a bird's eye view or an overview of some of the results that we obtained. Next.

Here you can see a survey of the diet quality over the four years that these children were followed. You can see this is a composite score collected over the six surveys. And over this time period on the left-hand side of the slide, you see the grains and dog were consumed by most of the children at most of the visits. Whereas at the right hand side of the slide, you can see that milk, meat and eggs were consumed considerably less often. Next slide.

This slide shows some unadjusted and cross-sectional data at midline in the top panel and an end-line in the bottom panel. The ASQ results are shown by percentiles, the upper 75th percentile in green and the lowest 25th percentile in red. And here you can see that the developmental status of the children related to diet diversity at both of these time points, midline and endline children with higher ASQ scores also had higher diet diversity scores. Next slide.

The very same pattern was seen for ASF consumption again, midline on the top and endline on the bottom. Next slide.

We then wanted to look at specific food groups again at midline and endline. And here you see ASQ scores and continuous results. Children who consumed milk, meat, eggs, and yellow fruits and vegetables shown in blue had higher ASQ scores than those who did not consume these items shown in purple. And these results were particularly striking at endline. Next slide.

This brought us to the question, what is the relation between child diet and development in this young group of children after adjusting for confounders? And we were able to include diet records from the first three surveys and compare these to the ASQ developmental performance at the midline survey in this group. Next slide.

Here, you see the results of that assessment. We found that some dietary components were positively associated with better child developmental performance. The Y axis shows the beta coefficient, which indicates the increase in ASQ score for each time out of the three household visits that the child consumed the item. Thus the ASF was about six points up for each time and any fruits or vegetables about nine points up in the total ASQ score. Next slide.

We next wondered whether these relationships could be confirmed over a longer time span and a broader age range. To address this, we looked in specific detail at the group of children who had six household visits and complete dietary information over the four years and an ASQ test at endline. Next slide.

Here you see the increase in ASQ score for each day out of six the item was consumed. On this slide is the unadjusted results for eggs, milk, meat, yellow fruits, and vegetables and ASFs.

The next slide shows the same results after adjustment for maternal household and child factors. The results were greatly attenuated, milk, yellow fruits and vegetables in any ASF did retain significance after this adjustment. Next slide.

We then wondered what other household factors are important. And thinking back to the diagram that Andrew showed, we focused our attention on household wealth, maternal education and home child rearing quality. This slide shows the overview of the developmental status and household wealth at midline and endline. And at both of these time points, children with higher ASQ scores had higher wealth scores in their households. Next.

Here is a slide showing the developmental status and mother's education ASQ score here is shown as a continuous variable, and you can see quite easily that at both the time points, the more education the mothers had, the higher, the children's ASQ score. Next.

And here is the home quality related to developmental status. Again, not surprising higher ASQ scores in children who came from homes with higher home quality index. We use these and other findings to develop our full model to assess the impact of child age household wealth, maternal education, child diet and home quality on child development. Next slide.

When we ran the model, household wealth dropped out as significant, and it was obvious to us, the child's diet and home qualities stood out as perhaps the most amenable of these factors intervention, at least in the short term. Next.

Our last research question is shown here, are there any age related differences in these associations? And we had a group of children who had been tested at two years of age, and at five years of age. This is a very, very important period and was of great interest to us because this brackets the second thousand days, a period of great importance in early childhood, but about which much less attention is given than the first thousand days. Next slide.

We also asked the corollary question in this group of whether any of these findings related to specific developmental domains. Next slide.

Okay. As you heard from Dr. Merina, the ASQ is composed of five specific domains, communication, gross motor, fine motor, personal social, and problem solving, which are added together to develop the full total ASQ score. We wanted to see the relation of these scores to mother's education, household wealth and child ASF consumption at these two ages. Next slide.

Here are the... Go back one, please. No. Back, back, back. Yeah. Here are the results. That's the one. Here's the results at age two and the positive and significant associations are shown in red.

You can see that child ASF consumption related positively and significantly to the personal social domain, as well as to the total ASQ score. And household wealth to the fine motor sub domain. There was no relation of maternal education for these very young children. Next slide.

Here you see the dramatic differences for the children at age five, and you can also notice that we've added another variable, child being in school. Because by this age in rural Nepal, a significant number of children are attending various preschool programs. So we can see that mother's education, household wealth, child ASF consumption, and the child being in school all related strongly to the problem solving domain, the fine motor domain and the total ASQ. In addition, child ASF consumption was associated with the communication subdomain and the personal social subdomain. That's the findings at these two distinct ages were quite different. Next slide.

Our studies had some strengths and many limitations. As strengths we had cross-sectional and longitudinal results. We had dietary information six times over four years, which was able to provide a detailed picture of child diet. Some limitations that we needed to be aware of are the small sample size. Also food quantities were not measured, and this might be very important

because some food items may have a threshold effect. When we think about their relationship to child development. Also the ASQ standard has its advantages, but we recognize it is not the gold standard. Although we found it informative and practical for use in the household under field conditions. We also recognize that our home quality measures were self-reported and not independently verified. And as in any studies, any type of study of this kind, unmeasured variables likely affect the outcome. Next slide.

We conclude that dietary quality over time is associated with child developmental performance. And that the strength of this association between diet and ASQ was attenuated by adjusting for confounders. We found that multiple aspects of diet, and not just ASFs, are important. And there was a particular interest in some of our findings related to yellow fruits and vegetables, perhaps as a marker of diet diversity. We also emphasize that many household factors are important in addition to diet, and these relationships between household factors in child development vary with child age. Next.

The world health organization stated in 2018 that early child development is a cornerstone of human development and should be central as to how we judge the success of society. I want to echo Andrew's words in saying that we hope that this webinar may inspire the child development and the nutrition worlds to start talking even more. And for us in the nutrition world, to recognize that child development should be considered as an important measure of child wellbeing. Next slide.

I want to acknowledge all the people who helped in this work over the many years and the organizations that were very instrumental in carrying out this work, and mostly a huge thank you to the participating families who let us visit them six times. And we really appreciate that. Next slide.

Here's a list of references, and I think Devin can send this out to everybody. This describes some of the work that I presented today. Thank you very much for your attention. And it's really so exciting to have so many people here. Shabani over to you.

Irwin Rosenberg

While we're waiting for Shibani to come on, I just want to remind everyone that if you have questions relating to these interesting presentations, use the Q&A function, and we'll try to get to these questions after all four of the presentations. Shibani?

Shibani Ghosh

Yeah, thank you all. Apologies everybody, I was on mute. So thank you Laurie, fantastic presentation. I'm not sure how I can follow up with what you've already said, but I'm going to try. So thank you everybody for joining us from all over the world. Today I'm going to be talking about a very specific ongoing analysis on the relationship of animal source food consumption and metrics of child growth and development, which includes the ASQ scores. Next slide.

I just want to acknowledge the fact that I'm presenting on the behalf of a very large study team, and I've got the list of people in alphabetical order, as well as the institutions that have been very responsible and involved in this, in this piece of work. And I also want to indicate the fact that a lot of the work that we've done under the study called the Africa study was thanks to the support from the Bureau of Resilience and Food Security and, USAID DC, as well as USAID Nepal. Next slide please.

So I think everybody on this webinar is very familiar with why animal source foods are considered such an intriguing and interesting intervention strategy, particularly to provide all the

sort of dietary constituents that are needed, particularly for infants and young children in small quantities. Now, for those of you who might have attended our webinar earlier in the middle of last year, we had presented on ASF consumption and it's a relationship with stunting and wasting. And this was work done by my colleague Sonia Zaharia. And what she found was that when you measure ASF consumption using 24 hour recalls, and in a ladder manner where you're looking at later on stunting, there is actually a decline in stunting in those kids who have received ASFs. And what was very interesting from her findings was, it was not just only if the child had consumed any ASF, but if the child has had two or more ASFs the benefits were even greater. And of course there's a slew of literature. I'm not going to go through it on the role of ASFs in supporting not just the physical development, but as well as cognitive development. Next slide please.

So based on what Andrew, Merina and Laurie have been doing in the different research sites that they been working in, we wanted to sort of utilize the ASQ work that they had done and ask the questions on some of the research sites that we had been working on in Bankie in Nepal, and really asked the question if there was an association between ASF consumption at different time points in early life. So we are starting at 6 months of age and going through about 24 to 26 months of age. And assess the relationship, age-related relationships from early life through about 24 months of age, but also assess if there is a relationship or an association of consistent and cumulative consumption of ASFs over time. Now, for the purposes of this analysis, we use not only the ASQ scores, but we also use length for age Z scores, which is the metric, which is used to assess standing in a population. And we also included a head circumference for age Z score. And I'm just going to zone in on that particular metric for a second and tell you that head circumference measures are often used in anthropometric assessments. We don't normally report on head circumference for Z scores, but what my work and my interactions with Laurie has given me the knowledge that in fact head circumference for age Z score is a very simple metric to assess brain growth. It may be a good proxy. It may not assess all of brain function, but it may be a good proxy to consider down the road. Next slide please.

So let me just talk about the study a little bit. You all might be familiar or not, Aflac cohort, which is essentially a longitudinal birth cohort was conducted in the Bankie district in Nepal, which is where Laurie and Andrew and Merina have also been working on all the other studies. And this was an observational birth cohort, which followed 1,675 mother/infant dyads over a period of three years. Next slide please.

So this is just to show you how our study evolved. Now, the reason it's called Aflac cohort is because we were assessing the original objective of this study was to assess aflatoxin exposure in pregnancy through the first two years of life and assess the relationships with other factors that could correlate with stunting and wasting in this population. So the Aflac cohort study was conducted from 2015 to 2019. As you can see, there were two phases. And the point I want to make here is that we were fortunate and able to follow these 1,675 households from the point of pregnancy birth and every three months after birth, until about 12 months of age. Subsequent to that, we were able to follow the children and the mothers every six to eight months in the phase two. So based on this, we were able to, based on the phase two data, we were able to identify 730 mother/infant dyads who had a complete data set for us to utilize for this analysis. Next slide please.

So what do we have in terms of the data? We have longitudinal data, as I mentioned from starting from birth, but for this specific analysis, we are using data from the time point of the child being 6 months, 9 months, 12 months, and 18 to 22 months. And what we'll be looking at,

the consumption of animal source foods, as well as all other food groups in the past 24 hours and past seven days. We also had data on length and weight that would allow us to compute the necessary anthropometric markers, as well as head circumference. And then we wanted to look at the breastfeeding status. Of course there are metrics that were used or the measurements that were used where ASQ questionnaires and length, weight, and head circumference measurements at 24 to 26 months. These were used for our outcome measures. Now we had data on the children on both ASF consumption and a complete ASQ survey at 24 to 26 months. And we included these in the analysis. Just to give you an idea the ASFs included more milk, yogurt, eggs, chicken, goat meat, buffalo, pork, large fish, small fish, and dried fish. So it was a very comprehensive assessment of ASF consumption in this population. Next slide please.

In terms of the outcome measures, we looked at cumulative ASQ scores. We have not actually disaggregated just yet by the four domains that Laurie and Merina have presented. We looked at length for age Z scores as a continuous variable and head circumference for age Z score. In terms of the independent variable, particularly around ASF consumption by time point, we looked at if the child had consumed any ASF at all, the total number of ASFs the child consumed and the frequency of ASF consumption in the past 24 hours and in the past seven days. So these were all age disaggregated indicators or variables, but we also created a cumulative variable where we assessed the number of ASF consumed across all ages, starting from 6 months of age through 18 to 22 months of age. And we had an accumulative frequency of ASF consumption again starting from 6 months of age to 18 to 22 months of age. Next slide, please.

We conducted descriptive statistics as well as bi-variate analysis. And then we used ordinary least squares regression analysis where an adjusting for clustering, because we had households that were identified in communities, local communities, or clusters. As I've already mentioned, our outcome of interest for each of the regressions was the ASQ score, the head circumference for age Z score and the LAZ score. We did consider all potential covariates and confounders, which have already been identified by Laurie, which includes the wealth of the household, the education of the mother, the age and gender of the child, as well as the different food groups, other food groups that the child has consumed. The one key thing we found out while we were looking at breastfeeding status of the child and for inclusion in the models, we found that 73% of the children in our study were exclusively breastfed up to three months of age, and 95% had continued breastfeeding from six months onward. Given this, we found that adding the breastfeeding status to the model did not really have any effect on the model. So therefore we left that variable out. Next slide please.

So this is just a list of descriptive statistics. What you can see is we had about 702 children that we had complete data on. And we had about, as you can see from the second row, it's the head circumference for age Z score and the LAZ score. They were pretty low, which is telling you that there was significant undernutrition in this population. We had a very equal number of girls and boys in our population. And then you can see what the maternal education status was. Where about 37% of the women were had received no schooling. Next slide, please.

This is just to show you how the ASF consumption changed over time. On the left side of the screen is ASF consumption in the past 24 hours by the age of the child. And you can see, of course at 6 months, there's just under 30% of the kids that are consuming any ASF. And that goes up to about 60% by the time they are 18 to 22 months of age. On the right side, what we have is the mean consumption of ASF in the past 24 hours, it's a mean number of ASF consumed as well as the frequency of ASF. Again, similar to whether they consumed ASF or not, there was

an increase overtime with a very small mean number of ASFs consumed by 6 months olds, as well as the frequency of ASF. Next slide, please.

This is just to give you an idea of the types of ASF consumed, not surprisingly milk was the first and most common milk that was consumed. And on the left side, what I'm presenting is the ASF consumption in the past 24 hours. And on the right side is ASF consumption in the past seven days. And that consumption of milk did not change. What you do see in that 7 day period that children are more likely to have been given chicken and goat. Whereas in the past 24 hours, it's likely to be milk, yogurt, eggs, and some chicken. What we also found that the 7 day frequencies and a number of ASF consumption did not differ as much from the 24 hour data. Next slide please.

So I'm going to go into some of the regression models that were run in. The first one that we will look at is where we looked at what was the association of ASF consumption in the past 24 hours or in the past seven days, or the accumulated ASF consumption over the different age groups and the ASQ score at 24 to 26 months. What you see here in red is the significant coefficients and what we find for the past 24 hours that consumption of ASF at 18 to 22 months was significantly related with ASQ score at 24 to 26 months. Similarly, in the past seven days, the value at 12 months was significant. In terms of the cumulated ASF consumption, it's seen that both the past 24 hours and the past 7 days was significantly associated with ASQ scores at 24 to 26 months. Next slide, please.

In terms of heads circumference for age Z score, again, we find very, very similar findings. That is the older age group, where the children are consuming more ASF seem to be more strongly and significantly correlated with heads circumference for age Z score at 24 to 26 months. The relationship of cumulative consumption of ASF and heads circumference, for age Z score is very similar to the ASQ score. Next slide please.

We also wanted to look at LAZ in terms of a dependent variable. And what you see here is that we didn't see a significant relationship of ASF consumption in the past 24 hours at any time. What we did see was a relationship when we examined ASF consumption in the past 7 days at 12 months of age and at 18 to 22 months of age. When we assessed it as a cumulative ASF consumption, starting from 6 months to 22 months, we find that there is a significant relationship between a LAZ at 24 to 26 months and ASF consumption as a cumulative metric. Next slide please.

So what we seem to find consistently across all three metrics is that cumulative ASF consumption measured starting from 6 months of age to 22 months of age is associated with improved ASQ scores, with improved head circumference for age Z scores, as well as improved land for LAZ scores at 24 to 26 months of age. What we seem to see in this age dis-aggregated analysis is that the significance varies by age and by outcome in general. The association, however, seems to be significant at an older age. So does that mean that early life consumption matters or not? But I don't think this is very straightforward. Of course, one of the things that we find is that the consumption of ASF in early life at 6 and 9 months is much lower than the older ages. The measure of the ASF does seem to matter, as does the age of ASF introduction. Next slide, please.

We do have some strengths in our analysis as well as limitations. We were fortunate to have data starting very early in life, and we're looking at introduction of ASF at a critical period in the child development. The second thing I'd like to add is because this was longitudinal data, we were able to follow the same child over time, and that provides a robustness to the findings. And it allows us to assess the relationships, the land relationships of early or later introduction of ASF

and subsequent ASQ or LAZ metrics. One of the limitations that we do want to point out that our diet data was collected through 18 to 22 months of age, but our ASQ surveys were done at 24 to 26 months of age. So they could have been dietary effects between those time periods, which obviously we are not able to capture in this analysis. In this whole process, I've not really talked about any of the other food groups and that's something that we are exploring given the fact that while we do not see any relationship with vitamin A rich foods and vegetables, we are seeing any other fruits and vegetables appear as similarly significant as ASF consumption. So that's something that we are working with Laurie and colleagues on our study team to assess further. We also want to sort of assess if it's possible with our data to see if there is an inflection time, point or age when the introduction of ASF might matter the most, which really requires us to look at within age group and not just across age group introduction of ASF and the outcome metrics. And so, and as I've already mentioned that we would really like to assess the relationship of the other food groups across these different development measurements over time. So thank you very much for listening and I will hand this over back to Rosenberg.

Andrew Thorne Lyman

I think am I next actually?

Shibani Grosh

I apologize, Andrew. You're next, yes.

Andrew Thorne Lyman

Okay. Thank you very much Shibani. So I'm going to just provide a quick summary of findings. Next slide please.

In terms of what we've learned. So I think our general experience has been that applying the ages and stages questionnaire, this tool, in a rural setting actually worked quite well. You know, I think we found that it was feasible. It was not overly burdensome. I think Dr. Shrestha can speak in the Q&A about our experience. I see that there's been a lot of questions about, you know, sort of how long did it take and what was your experience adapting it, and how suitable or some of these questions, because we know that there's some questions in it, you know, that are probably more geared towards a Western population. And so how did we adapt that? So we'll talk about that in a bit. We did observe a lot of associations that we expected to see between dietary quality and children's development, both overall, but then also in certain specific aspects of child development. Let's see, we did find an association between animal source foods and total development. And you know, that made sense. You know, we also had a paper that was published early on from Bhaktapur that looked at vitamin B12 status and the association with child development that really supports, you know, some of those associations as well. That B12 in particular might be, you know, an important component of animal source foods. But also interestingly, I think it's important not to ignore the fact that also we found associations with vegetables, and vegetables could also be important. You know, I think in general though, I think that the association between dietary quality was important and it was consistent across studies, which is important as well. Next slide.

We also learned some things as far as the methods. And I think obviously these are just observational studies and as such, you know, there's always this possibility of unmeasured

confounding. You know, we did see that a lot of the associations between dietary quality and child development were attenuated when we adjusted for things like maternal education, and socioeconomic status, not fully attenuated so much that there was an old relationship, the relationship persisted, but it was attenuated. So clearly there is this clustering of sort of the poverty within poverty. You have all of these different dimensions and they're all sort of associated. And so teasing them out, you know, can be difficult. We used a number of different dietary assessment measures in these different studies, you know, from 24 hour simple frequency, did you consume this? Yes, no. To a longer seven day recall of the frequency of consumption of different items. And when we put together different types of scales there, what we found in general, which is not unexpected is that, when you have just one 24 hour recall, and you're trying to find associations with anything, any health outcome, I mean, this has been very well-documented in nutritional epidemiology is that you have this sort of misclassification when you're trying to represent usual diet over time with a one-time measure. And as a result, I think it can be very difficult to detect associations with any outcome when you're only relying on sort of one cross-sectional measure. And so having the longitudinal sample over time, I think really helps us to better characterize what is usual diet. You know, I think we also did find associations between when you look at the number of different animal source foods consumed that can be powerful. And you have that open question of whether that may be some sort of association with socioeconomic status. And so maybe the households, the same type of possible who are able to feed children eggs and milk and meat, you know, that those are wealthier households, but perhaps also these, you know, perhaps this classification of animal source foods and sort of lumping everything together in that category is not necessarily the best way to look at things, given that these different types of foods have different nutritional content and different properties. So perhaps we should also, in addition to thinking about this as a category, we should think about the individual foods, and what they contain and to treat it that way when we analyze data as well. We treated both the exposure and the outcomes both as continuous and dichotomous. And obviously when you have a continuous exposure and a continuous outcome, you have more sort of ability to detect associations than when you dichotomize things. And also for some of these, in many of these studies, we found associations that were present among older children rather than younger children. I think by the time children reach five years of age, there's sort of a wider range of development. So I think it can be easier to capture associations with environmental factors as well. And in some, just another thing that had to do with the use of the ages and stages questionnaire, in some of the components of the scale, some of the questions we did not find a lot of variation in some of those. And so I think that really suggests that there is additional sort of adaptation that we could make to the tool to make it better suited for application in this rural Nepali context. Next slide please.

So I think, you know, we've learned a lot, and I think that there are a lot more questions, you know, in science, anytime you think you have an answer, it opens up a lot more questions. And so I do think that further adaptation of these types of tools to the local contexts would be useful. You know, this was one tool and there's now several other free tools, which are either in development or already available for assessing child development. And we know that the mix has a great tool as well. So I think there are a lot more tools than there used to be when we first started doing this research. And it'll be interesting to see, you know, which tools are best suited for use in different types of contexts or different types of uses. I think, you know, Dr. Shrestha can talk about, you know, the use of the different tools in Bhaktapur, you know, which was the

setting where we were actually able to apply things like the Bayley and other measures, you know, which provides sort of a more nuanced and sophisticated way of measuring different dimensions of child development you know, but I think that it's important just to keep in mind that, you know, there are a lot of tools and the best tool for, you know, for youth and research, you know, may not be the best tool for use in screening children, for example, in a rural context. So it's important to think about, you know, where do we use these different tools? I think it's also, you know, there's been a lot of talk about, you know, nutrition and ECD coming together and you know, working together and having these integrated interventions, you know, that promote, you know, responsive care giving and responsive feeding, and early child development activities. Along with nutrition, there's been very little discussion about agriculture actually within this. And so I think just thinking through some of the dimensions there, for example, we know that rural agricultural households life is very seasonal. You know, when it's planting season and harvesting season, those are times when perhaps households may have additional childcare needs. And so what can be done about that? I think trying to view ECD support from the standpoint of, you know, rural agricultural households could open up, you know, ways of helping to address some of the challenges here. And another thing, which we didn't talk too much about today, but which we have another study that will be published soon, it's just maternal depression. We found that it's highly prevalent in rural Nepal and probably, you know, it's a very important thing that needs to be addressed in order to address child development as well. And the last thing, I think Jackie Lauer presented as well. It was just, in terms of you know, I think there's open questions about how well some of these measures of early child development track towards later outcomes such as achievement in school, but also, you know, subsequent outcomes as well. And there's a lot of open questions about that. Last slide, please.

I would also just like to end by just saying, you know, this, the Lancet series on child development showed that in a lot of countries throughout the world is, you know, not only is child development associated with poverty, but the delivery of interventions such as early education is also very strongly correlated with poverty. And here in Nepal, you can see that the proportion of children in early education varies dramatically depending on, you know, the household's socioeconomic status and the wealth quintile from 40% all the way up to 80%. And so trying to, you know, target interventions to those who need them most is something that really needs to be improved. And I'll end it there, and hand it over to Dr. Rosenberg for questions.

Irwin Rosenberg

Well, thank you very much, Andrew, thank you particularly for those summary, comments, perhaps we can have other comments at the end in summation. I'd like to look at many of the Q&A's questions that have come in, some of which you have just mentioned. And some of them address the question of whether we have information about some of these metrics, like age and stage questionnaire, which project to a later development beyond early child development. I don't know whether you have any information about that or whether Dr. Shrestha has information about whether age and stage questionnaires project to later performance, in school and so forth. Obviously in a very important part early child development it is how it prepares the individual for a later development and maturity. Dr. Shrestha, do you have any data on this?

Merina Shrestha

For age and stage questionnaire projecting the school preparedness? So I don't have any data on that, but there are other developmental assessment tool we use for the school preparedness, and in Bhaktapur itself, we are doing (...) scale and we are doing (...). So that might be helpful to see the school preparedness, but ASQ itself does not project for the school preparedness.

Irwin Rosenberg

Thank you. Another question, which has been repeated is looking with further granularity at the information, the nutrition information and the relationship between some of these elements in early child development, including the ASQ. Obviously animal source foods are a source not only of macronutrients and protein and so forth, but also micronutrients. And there is some information about other micronutrients in the diet. I wonder Laurie, do you have information about other micronutrients, and Dr. Shrestha, maybe you can go further with some of the interesting questions about vitamin B12 as indicators in their relationship to some of these child development measures.

Merina Shrestha

Yes, we did have the stages and vitamin B12 in infancy, children in Bhaktapur, and we found around 17% of the children were vitamin B12 deficient during infancy. And it is also found that their cognitive outcome was poorer than those who have sufficient vitamin B12. And recently, we have published one RCT where we supplemented children with vitamin B12, but the dose was not too high, it was only two microgram. But with that supplementation, we didn't see the difference in the cognitive development. However, we found that there is definitely a change in metabolites of the vitamin B12 with the supplementation.

Irwin Rosenberg

Laurie Miller, Does your data shed any light on these associations?

Laurie Miller

Well, I wish we knew more about this. It's certainly an important area. As I mentioned, we were particularly intrigued by some of the findings related to the category of vitamin A, rich fruits and vegetables. And I'm not an expert on vitamin A, I'm sure other people on the call, including yourself, Irwin, are much more expert about vitamin A, but we do know that there are links between vitamin A and neurocognitive functioning, vitamin A is important in preventing neurocognitive decline in older adults, and in young developing children. It's very important in regulating some neurogenesis and synaptic functioning as well. And in animal studies, I believe it's been also implicated in learning and memory and particular vitamin A receptors in the hippocampus. It may also be associated with iron consumption in that category, as well as iron absorption. But it's very interesting to us that this is a group of children who were receiving as per the Nepal government protocol, regular supplements with vitamin A. So we really don't think they were vitamin A deficient because we asked at each of the visit if they had received the supplement, which is given every six months to young children in Nepal. So maybe there's other Korat noise or other other nutrients or elements in that category of food that we don't even know about yet. And certainly we need to understand more about that as well as the whole story about iron, which we haven't talked a lot about.

Irwin Rosenberg

Yes, that's certainly an important element, not only animal source foods. Do you, Andrew, have any further information or insights about micronutrient relationships with early child development?

Andrew Thorne Lyman

Yeah, I mean, I think, I mean, there's some wonderful review papers. There's a great paper by Beth Prato and Kay Dewey, on you know, different micronutrients and the role in brain development. You know, I mean, one thought I had, when I'm thinking about vitamin A is just, there's a great paper you know, from Dr. West and others at Hopkins looking at vitamin A down in the [inaudible] vitamin A supplementation and finding that supplementation in preschool was associated with subsequent risk of hearing loss and ear infections as well later on. And perhaps, you know, and, and we all know that I think, you know, hearing loss is also a major risk factor for adverse development outcomes. So it's not, I think, beyond the realm of possibility that that could be important. But I also think, you know, just thinking about the vegetable findings, you know, I've been spending a lot of time thinking about that. And, and I think, I think we also just need to appreciate that, you know, it takes time to cook. It takes time to prepare a diverse meal and the more items that are being prepared, I mean, that also in itself probably represents something and perhaps that's correlated with stimulation or it's correlated with something else, you know, behavioral. So it may not just be biological, I mean, there may be something else going on there that we need to study and, and understand that.

Irwin Rosenberg

I'm glad to learn that Johns Hopkins continues to contribute to our information about the importance of vitamin A, in relation to infection maybe in this case, the middle ear. So we have some additional questions for Merina Shrestha about the ASQ too. Is there a sex disaggregation aspect of the use of this tool, and also can you comment about how long it takes to administer this tool?

Merina Shrestha

Ideally it takes not more than half an hour. Most of the time we are able to finish by 15 to 20 minutes, but especially in very young children, it might take a little bit longer. Otherwise it's very easy to assess, but we have to make sure that the child is well fed, not wet and not sleepy. If three things are there, then it's very easy and we can finish in 15 to 20 minutes.

Irwin Rosenberg

Thank you. Shibani we have a question also about methodology here. How does one go about assessing the seven day animal source food consumption or other aspects of the diet?

Shibani Ghosh

Yeah, thank you very much Irwin. So we, in the Aflac cohort study, we had utilized a 7 day qualitative recall in which we requested the mother to respond to a series of questions against each food group. So essentially it's a simple tool that was used to assess the 7 day. And it's very similar to asking for a 24 hour qualitative recall. What we weren't able to do was take, for example, the ASFs and each of the different food groups and break them down by food items,

which is why we are able to look at not just the aggregated food groups, but look at the food items as well, and the frequency of consumption.

Irwin Rosenberg

Thank you. And do you have any information in your studies about micronutrient specifically and the associations?

Shibani Ghosh

Yeah, no, so one of the things we, in the Aflac cohort study where diet piece of the study was very much a qualitative assessment that was conducted. So we are able to look at micronutrient intake from a qualitative perspective. And in terms of micronutrient status of the children, we actually did collect our samples, could be analyzed for micronutrients, but I think the Nepal was having a big micronutrient study at that time. So we weren't able to do the micronutrient markers in our study at the same time. So I think, yes, we are able to give some kind of a proxy of micronutrient availability in the diet, but we don't have micronutrient status in this population.

Irwin Rosenberg

Thank you. Well, this has been a very rich presentation of information and studies and powerful developing methodology. And I really thank all four of you for these presentations. I wonder if we could use some of the last five minutes to have each of you give a further emphasis of the takeaway lessons from your own experience. And Shibani, let's start with you since you have the floor.

Shibani Ghosh

Sure, sure. Thank you. I think somebody made a very good comment in the Q&A to which we haven't been able to respond. We are in this particular analysis, we are looking at ASF consumption and we have to sort of manage what are we seeing in terms of intervention strategies around diet, and particularly ASF consumption, given the sort of larger context around, you know, livestock ownership and production and productivity and climate change. So I think that's something we, you know, I'm always thinking about. And I wanted to make sure, I mentioned that, you know, we're talking about very, very small quantities of animal source foods are needed to achieve the required nutrients, the micronutrients specifically, but also high quality protein for these kids. So I will say that and pass it on to the next person who probably would be Laurie. I don't know Irwin if you have a list, you have a...

Irwin Rosenberg

Laurie, do you want to use a minute or so?

Laurie Miller

Yeah. Thank you. I'm excited to hear Shibani's most recent results and think that they really emphasize the importance of our thinking about critical periods in this early, very important time of child life. And this is a time when complimentary feeding has been introduced. It's also a time when there's a lot of growth faltering, and I think we recognize that there are different inputs that come into play at different times for linear growth, for ponderal growth and for head circumference, and also for the different aspects of child development. And I think it's going to be very fascinating to try to pick these apart and understand it better. And when you are able to

look, Shibani at some of the age groups in much more granular detail, I think this is going to give us a lot of clues about how these critical periods operate and threshold amounts of food and timing. It's very important information to understand for basic human biology, as well as to have a way to think about intervening, to help children in need.

Irwin Rosenberg

Merina Shrestha, do you have some comments for us?

Merina Shrestha

Yes. Though ASQ is yet to be validated in Nepal, what I think it can still be used in a large researches so that we can compare different communities. We can compare different sub group of children in Nepal, and that is one thing. And another thing like using when using is it's not only teaching the fieldworkers, the parents are also learning how to play with children. And that is another good point about ASQ that I like. Over to you Andrew.

Irwin Rosenberg

Thank you. And Andrew we'll let you have the final word here about where this important progress that needs to go.

Andrew Thorne Lyman

I mean, I guess I would end with something that I didn't talk about, or we didn't talk about today, which is also just the importance of thinking about pregnancy, you know, as well, you know, that here, we're looking at the children's diets and what we've presented, but, you know, it also starts in pregnancy and possibly even before pregnancy. And so that's another frontier that I think, you know, needs more study. I mean, we know for example, from the fish world, you know, that something like DHA and fatty acids and pregnancy seems to be associated with child development later on. And so I think also thinking about pregnancy is a really important thing going forward. But I would also just like to, there are lots of questions about, you know, where can I find the papers and, and Devon, I don't know if you can address those, they should be up on the Feed the Future, Nutrition Innovation Lab website. And if they're not there, I think can put them alongside this presentation, right?

Irwin Rosenberg

Well, thank you all for your participation and Patrick, do you want to close the meeting?

Patrick Webb

No, please go right ahead. Thank you everyone.

Irwin Rosenberg

Well, thank you all. And I guess I would even add to Andrew's challenge about including elements during pregnancy with these analyses to actually increase our vision to pre pregnancy and preconceptional status and information. But I think this has been a very important focus on these relationships. Thank you all for participating. Thanks, particularly for the presenters.