



FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

Assessing Predictors and Metrics of Diet Quality in Sub-Saharan Africa and South Asia : The Intersection of Agriculture, Nutrition and Health,

Webinar Transcript

Katie Heneveld

Good morning, good afternoon, and evening. Thank you all for joining today's webinar to learn more about Assessing Predictors and Metrics of Diet Quality in Sub-Saharan Africa and South Asia. My name is Katie Heneveld, and I am an assistant researcher for the Feed the Future Innovation Lab for Nutrition and will be your MC for this webinar today. As attendees are joining, I will begin by going over some housekeeping items. I'd like to direct all attendees to a few functions on the Zoom webinar. At the bottom of your screen, you should see a chat icon and a 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 as they're able, and we have allotted the final 25 minutes of this webinar for the Q&A. If you're experiencing any technical difficulties, 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 in at later times. I'd like to begin by introducing Dr. Patrick Webb who is the director of the Innovation Lab For Nutrition and the Alexander McFarland professor of nutrition at the Friedman School of Nutrition Science And Policy. He will provide a brief description of the nutrition innovation lab before introducing the moderator for today's webinar. Dr. Webb over to you.

Patrick Webb

Well thank you, Katie, great pleasure, welcome everyone to this 11th webinar in this Feed the Future Nutrition Innovation Lab Seminar. A great pleasure welcome everyone to this 11th webinar in this feed the future nutrition innovation lab seminar. We're very happy that you've been able to join and looking forward to engaging with you as actively as possible during and potentially after this seminar. Some of you know others are newcomers that this is a series that showcases work that has been done over recent years by the innovation lab for nutrition, which is

a essentially a large group of partners, both in the US and around the world, and today you're going to hear some of the interesting insights coming from work in a variety of different settings, using a variety of different methods, but all in one way or another, bringing together attention on the quality of diets and links between agriculture and nutrition and health. As you see from this graphic, this map we have a lot of different kinds of research in a lot of different kinds of countries in Sub-Saharan Africa and South Asia. So primary data collection relating through RCTs and observational studies, epi studies, secondary data analyses, lab work with blood draws. You name it from the very micro to the very macro policy level.

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This can only be done with a really important and cutting edge set of colleagues and partners all around the world. You're going to hear from some based primarily in the US today but who've engaged with us over many years and have brought an amazing array of skill sets to bear on these very, very challenging questions that require sometimes very challenging approaches to find solutions.

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It's good to hear see that many people from around the world have joined. We also partner obviously with many different institutions in the us feed the future, as an all of government activity and we are very grateful to funding from USAID and other partners for this this supporting this particular work. Thank you.

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So it's my great pleasure to introduce the moderator for today, Wafaie Fawzi, a very important scientist who's been a key collaborator with the nutrition innovation lab from its very inception. He is the Richard Saltonstall Professor of Population Sciences and Professor of Nutrition Epidemiology and Global Health at the Harvard TH Chan School of Public Health. He's also Chair of the Department of Global Health and Population in this group. And his experience is vast. It goes back to his work at the faculty of Medicine University of Khartoum in 1986 and he's been a leading scientist in so many domains relating to public health, infectious disease, including HIV and TB. And now you're going to hear some of his insights and engagement directly with some of these research activities. So great pleasure to introduce colleague and friend, Wafaie Fawzi. Over to you.

Wafaie Fawzi

Great. Thank you so much Patrick for this very generous introduction and really delighted to be with you all for this webinar. An exciting series of webinars as Patrick has mentioned really that advances these issues that are important to all of us. The Nutrition Innovation Lab has been a wonderful community. You see all the logos on the screen but each one of them has behind them wonderful colleagues and friends, and really bringing together scientists in the US, many friends and colleagues many in Africa and Asia, and of course the generous support from usaid and

other donors. So provided me personally an opportunity really to learn more about these linkages between agriculture, nutrition and health which is the theme of today's webinar. For a long time, many of us in the nutrition field have tended to focus a lot more on what we term the nutrition specific approach to health from breastfeeding to supplements, and so on, without enough attention to all the other domains that impact nutrition and health from agriculture to food systems and so on. So it's a wonderful opportunity to bring together three outstanding speakers today who have been also focusing intently on these issues. One of the key sort of elements in this field that we are about to address today is, you know questions around metrics that's evident perhaps in the title of the webinar itself. I think one of the key words is metrics of diet quality and so that enables us to assess sort of the burden of sort of inadequate diet in food in a community, predictors of that suboptimal diet, and consequences as well. And so to have a robust way of measuring on diet quality and diversity is key and some of our speakers today have been doing ground breaking work in in this area. So without taking too much longer, I am delighted to introduce our three outstanding panelists. I'll present three and then we will hear from them in sequence, and there will be a lot of time for discussion as well. First we will have the opportunity to hear from Dr. Isabel Madzorera. Isabel is a postdoc at the Department of global health and population at The Harvard T.H Chan School of Public Health. She did her doctorate at Harvard her master's at Tufts; and has done work prior to that in her native Zimbabwe. Her interests are on the intersection of agricultural nutrition and sustainable diets. She has really extensive experience in the field. Sort of in addition to her academic achievements, she has actual practical experience with a number of organizations in the field, say the children, UNICEF, Ministry of Health of Zimbabwe, the World Bank, and others. So delighted that she can sort of harness these two elements together in today's presentation. Next we'll hear from Dr. Elena Broaddus who is a senior instructor in the Department of Family medicine at the University Of Colorado School Of Medicine. Elena completed her PhD in international health at the Johns Hopkins Bloomberg School of Public Health. And her current research focuses on the integration of strategies to address food insecurity and other social needs within primary care. She has extensive experience in Nepal and other settings, but I think for today she will focus on the work with the Poshan community that she has used to advance some important research questions that she would share with us. Last but not least is Dr. Andrew Thorne-Lyman, who is an associate scientist and a nutrition epidemiologist at the center for nutrition also at Johns Hopkins. Andrew has his doctoral training from Harvard Masters from Johns Hopkins, and really extensive research and track record addressing food systems, diet nutrition, and health outcomes, as well as the development and validation of indicators to measure the effectiveness of nutrition programs. You will notice that there is already a theme that's emerging, the three of them have worked on similar topics, they come from similar backgrounds from Harvard to Hopkins to Colorado to Tufts, and that's really sort of an example of the Innovation Lab. It's the community of people who have worked together for a long time and always keen to extend that network to many more people over the next few years, we hope. So we will proceed then with our first presentation. Each presenter has about 17 minutes and we will have a chance to do a Q&A at the end. If you have any questions or clarifications, please feel free to add them to the Q&A and a part as we have been told. And I'm looking forward to a wonderful webinar so Isabel.

[Isabel Madzorera](#)

Great thank you. Good morning, good afternoon, and good evening to everyone around the world. Thank you very much for joining us for this webinar. This morning, I will talk a little bit about diet quality. My presentation is in two parts. The first part focuses on the association between diet quality and poor outcomes during pregnancy in urban Tanzania. And the second part looks at what are the predictors of diet quality for women in Tanzania.

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So, we know that sub-optimal diets are an important risk factor for mortality globally we also know that close to three billion people around the world cannot afford a healthy diet and we know that most affected are women and children because their diets tend to be monotonous, they tend to be plant-based, and also there's a limited supply of fruits and vegetables and this results in a lot of macronutrient deficiencies for this group. More broadly when we look at studies and programs that are focused on diets in low and middle-income countries particularly for women, they've focused on dietary diversity as a measure of diet quality. However my question throughout this presentation is whether we need to expand beyond dietary diversity is overall diet quality important in low and middle-income countries? That's my key question and this is particularly so when we think about the global dietary transition that's taking place, in particular does it matter when we look at urban or rural populations in low and middle-income countries? Broadly we can think of diet quality as being composed of three different components. The first one is one that relates to food diversity: where we expect diets that are diversified to be able to provide most of the micronutrients that people need for ... to meet their nutrition goals and to be healthy. The second aspect relates to moderation, where really we worry about moderating or limiting consumption of foods or food groups that we know have been associated with poor health outcomes. For example we can think of sodium or saturated fat as food groups that have been shown to cause ill effects. And therefore we want to restrict these. The third aspect for diet quality relates to balance where we want to first of all make sure that the energy composition of the diet does not lead to over nutrition, but also balancing the three macronutrients balancing protein, carbohydrates, and fats and how they the role that they play in the diet.

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In the study that we recently conducted and was published in the American Journal of Clinical Nutrition, we sought to understand the role of maternal dietary as well as maternal diet quality, and how they relate to the outcomes of quick pregnancy ... so adverse pregnancy outcomes in urban Tanzania. I will discuss this study a little bit more in the next few slides. So the study population for the study that we conducted in Tanzania was composed of about 8000 pregnant women, and these were women that were recruited in Dar As Salam, The women were part of a study called the Perinatal Study and the Perinatal Study evaluated multivitamin supplementation or placebo within this group and the supplements were administered during pregnancy and early into the postpartum period. For inclusion in the study, women needed to be between 18 and 45 years of age, and they needed to be within 12 and 27 weeks of gestation. We collected data on dietary intake multiple times during the pregnancy, using the 24-hour dietary recalls.

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Based on this dietary intake data that we had, we combined the data collected at multiple time points during pregnancy. And we came up with two indices that I'm going to discuss further. The first is the FAO Minim Dietary Diversity Score for women, and this is an index that many are very familiar with in this group. And this index is based on the consumption of 10 food groups. The index has been validated for micronutrient adequacy. However there's a gap in that we believe that the MDD measures only one quality... sorry ... one aspect of diet quality and that is micronutrient adequacy. Therefore it may not capture issues to do with nutrition transition in low and middle income countries. A second index that we also calculated in this population is the prime diet quality score. Now the prime diet quality score we use it as a measure of diet quality, and this has been applied extensively in developed country settings. It is composed of 21 food groups and of these 40 are unhealthy. The foods are shown there on the right. As you can see in the table on the left at the lower half of the table, we know that the PDQS is composed of healthy and unhealthy food groups, and the scoring for the PDQS is as follows: if you consume one serving or none of a healthy food group for the PDQ you get no points. If you consume two to three servings per week, you get one point. And if you consume four or more servings per week you get 2 points. And the scoring is reversed for unhealthy foods. As I alluded to before, the PDQS has been shown to predict ...to be associated with chronic diseases. In particular, it has been shown to be protective against cardiovascular disease, and has also been shown to be protective against gestational diabetes, hypertension, and pregnancy, and many other chronic diseases.

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In our study, just to run through this very quickly, when we looked at the association of the first score the MDDs with pregnancy outcomes, this is what we found. We found that women in quintile for the MDDW it adds up to 26% percent lower risk of small-for-gestational age births, when we compare them to women that were in quintile 1. When we looked at associations with pre-term birth, low birth weight, and fetal loss, we found no significant association for the MDDW.

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When we looked at the second index, the PDQS, and associations with the same outcomes, we found that women in quintile 5 of the PDQS had 45% lower risk of preterm births, and also 47 percent lower risk of low birth weight and fetal loss. And this is compared to women that were in quintile 1. We found however there was no association between the PDQS and small-for-gestational age are births within this urban population.

Next slide please so in conclusion we found that maternal dietary diversity and quality may be modifiable risk factors for adverse birth outcomes in Tanzania. We found that the PDQS which is a measure of maternal diet quality was inversely associated with pre-term birth low birth weight and fetal loss. We also found that the MDDW, a measure of dietary diversity, was inversely associated with small for gestational age. Therefore we believe that in addition to diet quality, we should also in addition to dietary diversity we should also consider dietary quality for women during pregnancy as a predictor or as a factor for poor birth outcomes and further study

of these two scoring systems in low and middle-income countries is warranted. So this was one of the few studies that have been conducted looking at diet quality measures in low and middle-income countries. And because we had this finding, we were curious to see whether diet quality is also important in our rural populations, and so we did the next study.

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So, the next study looks at the association of food crop diversity with maternal diet quality in Tanzania, and this study was recently accepted for publication in the *Journal of Nutrition* and should be out in the next few weeks.

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So when we look at the conceptual framework that relates on farm diversity... dietary diversity and ... market diversities as we can see from the conceptual framework we hypothesize that there are interactions between these three that on farm diversity can influence diversity, and that it can also influence market diversity, and that in turn market diversity can also influence dietary diversity, and that the interactions between some of these aspects also goes back and forth. In this current study, we thought that we would want to elaborate a little bit further on these interactions.

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We know from the literature that diversification of food crop production or livestock production is an important strategy to improve diet quality. We know that production of food crops increases the amount of calories and micronutrients available for consumption. We also know that the sale of these crops that are produced on farm provides valuable income for purchases of all households. Previous studies have found small positive associations between production diversity and dietary diversity. However the results really vary by geographical region in that some of the results are inconsistent, because the measures of diet quality used and the measures of production quality used tend to be different from study to study. In our situation, we thought we would evaluate whether agriculture production influences overall dietary quality for women in this sampling in rural Tanzania.

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The specific aims of our study was follows we wanted to evaluate associations between food crop diversity, women's access to income, and access to food markets and how they relate to our women's diet quality in Tanzania. We also wanted to evaluate the association or the effect modification of these associations by distance to market. Thirdly we wanted to evaluate associations between crop species richness with prime dietary scores. I will explain a little bit of these terms as we move along.

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The study population that we looked at was part of a clustered randomized prospective study. The study which is called HANU study is implemented in Tanzania and it's a homestead production intervention that produces a vegetables and promotes healthy dietary patterns, as well as our behaviors. The study has been conducted in a rural district in eastern Tanzania and at midline the study interviewed 880 women and these women formed the basis of my analysis today.

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So the exposure variables that we looked at include food crop diversity and food crop diversity is simply the number of food groups produced by the household, and this is derived from seven food groups that are taken from the MDD-W, excluding the animal source foods. The next measure is food species richness. Now food species richness is just a count of the food crop species that are produced by a household in the previous year. And this was derived from 37 food crops that we collected later on in the HANU study. The next aspect we also looked at was cash crop diversity and this was the number of cash crops that was grown by the household in the previous year. And these were cash crops derived from cashew, from cotton, and just one second ... sorry and sesame seed. And the other aspect that we looked at was market food diversity and this is the diversity of foods that is sold in local markets, and this was based on 10 food groups also aligned with the MDD-W. We calculated a median... sorry a minimum ... a median market food diversity based on information received from 27 key informants. Finally, we calculated the distance to markets for each household to two larger markets that were within the population's area of residence.

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Now going through the results, we saw that on average, BMI for women was a little bit high at about 24, and about 24% of the women in the study population were overweight. The majority of women had either primary school education or none, and only about 30 % of households owned chickens. The median market food diversity score was about 7.5, and this is out of 10 food groups. And the median distance travel to the market was about 1.1 kilometer. In this study, 21% of the women reported that they participated in non-farm income activities and 16% participated in salaried employment.

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When we looked at food production by the household in the study, we found that most households produced grains and dark green vegetables, and the most commonly produced crops were rice, maize, amaranthus leaves, and sesame seed. We also found that our food crop diversity in this population was low with household producing on average two food crops and the sale of households was done by about 51% of households with the most prominent crop sold being sesame. The median prime diet quality score for this population was 19 out of a maximum of 42, so it was quite low. When we looked at the consumption of healthy foods, we found that other vegetables, fish, legumes, and dark green vegetables were consumed frequently by a large

number of the population. However on the unhealthy foods, we found that consumption of refined grains as well as roots and tubers was also quite high. We also saw that consumption of healthy food groups, such as eggs, and poultry, and nuts was low with most of the population consuming a serving on none in the previous week.

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Now when we looked at the association of food crop diversity with a prime diet quality score, we found that growing an additional food group was associated with an increase in the maternal PDQS by 4.7 points. We also found that when women participated in paid or salary employment, the PDQS was higher by .96 point. In addition, participating... sorry in addition market food diversity was positively associated with the PDQS and it increased PDQS by .5 points for each increase in the food in the market a food diversity score. And the distance to market was negatively associated with the prime diet quality score. We also looked at effect modification by our distance to market in this study and we found evidence that the distance to market was significant as an effect modifier of this relationship between food crop diversity and the PDQS.

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So in this slide, we show the effect modification by distance to market. The P for interaction for the effect modification was .02. In Figure 3, we found that for women living closer to markets, food crop diversity had a higher estimated association with PDQS, and it increased PDQS by about .67 points compared to an increase of 4.0 points for those that lived further away from markets. And the median distance to market just to remind the audience it's about 1.0 kilometers.

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In the next analysis, we looked at the association of crop species richness with the PDQS, and we found you know in an adjusted model that production of additional food crops was associated with an increase in PDQS by 1.39 points. And we also found evidence that there was effect modification of this association by the sale of food crops. So for.... when we look at the association of crop species richness, we found that the association was stronger among women from households that sold food crops and it increased the PDQS by about .48 units compared to no change or no increase for households that did not sell food crops.

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In conclusion, we found that... we looked at the complexity of pathways from our food systems to improve nutrition outcomes for women. We found that household food production may act with both access to markets and access to non-farm income to... in its association with women's diet quality in Tanzania. We also believe therefore that policies and programs to improve women's diet quality should consider aspects of market access and women's access to all farm income in addition to diversifying household crop production. It is imperative for nutrition programs also to consider overall diet quality for women in low and middle income countries, including in rural locations based on the findings from these two studies. Thank you very much.

If we can go to the next slide. I would like to acknowledge the participants in the HANU study, and partners from IFAKARA, Sokoine University, the Harvard TH Chan School of Nutrition as well as The Nutrition Innovation Lab as well, as the IZUMI Foundation that provided funding for this. Thank you.

Wafaie Fawzi

Great thank you so much Isabel. Very clear and informative. We have a couple of comments and questions in the Q&A that are seeking some clarification. So I'm sure you will take these on... there and we will come back for Q&A from the audience at the end. Now it's a pleasure to move on to the next presentation and Elena will take us through. So Elena over to you.

Elena Broaddus

Yes, thanks, that's great. Can you hear me okay... yep. So hi everybody thank you so much for joining today. I'll be describing two analyses examining young children's consumption of non-staple micronutrient rich foods in Nepal. One examines seasonality and then one looks at the associations with small scale livestock production.

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So we know that diet quality is extremely important for children's growth and development, and that when diet quality is poor that can have lifelong implications. However like Isabel was mentioning, in many low income settings, diets primarily consist of staple crops like rice and other grains, which are not adequate sources of many essential nutrients[] are nutrient rich like fruits and vegetables and animal source foods are much less frequently consumed. So, increasing household access to and children's consumption of nutrient-rich foods is essential for improving diet quality.

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These are some examples of pro-vitamin A rich fruits and vegetables, which are one important category of non-staple nutrient-rich foods that we examined in these analyses.

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And then animal source foods, including dairy, eggs, and meat are another important category that we examined.

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So like I mentioned, I'll be describing the findings from two separate analyses that we conducted using the Poshan community surveys data. The first one examines seasonal variation in children's consumption of pro-vitamin A rich fruits and vegetables, eggs, meat and dairy. And this was across three different agri-ecological regions in Nepal. And then, the second analysis

examine the relationship between household livestock ownership and children's consumption of animal source foods.

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The data for both of these analyses came from the three sentinel surveillance sites, which were nested within the potato community studies in Nepal. So in these three sites, households were surveyed three times per year in three different seasons in order to capture a variation throughout the year. There's one site in each of Nepal's three regions, like I mentioned so one in the mountains, the hills, and then in the Terai, which is the plains region. For these analyses, we use data from one child per household, who is between 6 and 72 months of age, and these seasonal surveys were carried out for two years. So this meant that we had up to six data points per child. Data collected in each survey included the child's seven-day food frequency and this was assessed with a questionnaire that listed commonly consumed foods that had been developed previously during work in Nepal. And surveys also asked about the number of livestock that the household owns and about their expenditure on a list of individual food items over the days prior to the survey.

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So this diagram shows the time points when data collection was carried out. You can see that the surveys were done during the monsoon season, the post-monsoon season, and the winter season for two years. In Nepal, the monsoon and winter seasons are usually when food insecurity is highest. And so these are considered the lean seasons, while the post-monsoon season is when several key staple crops are traditionally harvested, and those households are usually the most food secure. Our previous... two previous analyses have looked at whether the consumption frequency of non-staple foods also follows these same seasonal trends or whatever. And so little previous work has looked at one of these patterns differ as well for non-staple foods.

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So I'll give a pretty abbreviated version of the methods that we used, but you can find the full version in our paper that was published in the journal *Current Developments in Nutrition*. We used longitudinal negative binomial regression to examine the association between season and then children's frequency of consumption of pro-vitamin A-rich fruits and vegetables, eggs, dairy, and meat. We stratified by region because we thought that the seasonal patterns may vary geographically. And we also tested interactions between season and past and season and wealth in order to see whether wealth or caste moderated the relationship between season and food intake. I should mention our wealth variable was generated based on scores from our household asset index and we divided that into three groups for this analysis. So we classified households as being in either the high medium or low wealth groups.

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So these plots show you model generated estimates for children's average weekly consumption frequency of each food group during each season. The plots are broken down by food group and then within each of the four food groups, we have a plot for each of the regions that we looked at. So the y-axis for each graph shows the average weekly consumption frequency for that food, and this red line is drawn at an average weekly consumption frequency of seven, which would be the point where the food was eaten once per day on average. Then the x-axis shows this for []winter.

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So looking at all four of these plots overall, the first thing they tell us is that consumption of all four food groups is very low. So looking at this red line, you can see that except in the case of berry in the hills region, all estimates were below seven times per week which means that all of these foods were eaten less than once per day on average across all seasons and regions.

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These plots also indicate where there's evidence of significant seasonal variation. So you can see here marked by the red arrows the model estimates indicate that average pro vitamin a rich fruit and vegetable consumption frequency in the mountains is significantly higher in the monsoon season than in the other two time points. And then in the Terai plains, it's almost zero during post-monsoon season and significantly higher during the monsoon and winter seasons

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For dairy, the model estimates suggest that the consumption differs significantly by season in both the mountains and the hills, with average consumption expected to be lowest during the winter in the mountains and then lowest during the monsoon season.

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And then, average egg and meat and fish consumption was basically very low overall without any significant variation, the one exception is this slight increase in meat and fish consumption that we see during the post-monsoon period in the Terai, which is indicative of this red arrow here.

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So we were also interested in examining whether seasonal variation differed past and by wealth level. So in cases where we observed seasonal variation, we also tested interaction terms to see if seasonal variation differed from []. So one example is this seasonal variation that we saw in pro-vitamin A rich fruit and vegetable consumption that we observed in the mountains which is circled here. So in the next slide, we're going to look at that same data but disaggregated wealth group.

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So again, this plot shows you that same seasonal variation, but by wealth group. So what this suggests as a whole is that in the mountains those who are wealthiest are somewhat protected from the decreased consumption that we see among those who are poorer in the winter and that wealth-based disparities in children's fruit and vegetable consumption are likely to be greater in the winter than they are at other times of year.

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And then another interesting example is this slight increase in meat and fish consumption that we see during the post-monsoon season in the Terai. So the next slide is again going to show what happens when we desegregate this by past []. So when we disaggregate we see that the increase in consumption is actually among children from Muslim households but not to Terai households. So this is an example of why it can be important to consider past and ethnicity when looking at seasonal dietary patterns in Nepal, and then more broadly it's an example of why it's important to consider seasonality in general. So for example imagine that you conducted a survey to examine dietary intake at just one time point, if you carried that survey out during the post-monsoon season in this part of Nepal, it would give you a different impression of the dietary intake of children from Muslim households than it would if you conducted it during the monsoon season or during the winter season.

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So based on this first analysis, we can conclude that children's consumption of non-staple nutritious foods is very low overall in Nepal it needs to be increased year-round. Second this analysis indicates that children's consumption frequency of pro-vitamin a rich fruits and vegetables and of dairy differs significantly by season and that those seasonal differences varied by region. So this implies that we need to identify and address season-specific barriers in order to improve diet quality on a year-round basis, and we need to use region-specific strategies to do this. And finally the findings indicated some differences in seasonal variation by caste past group and by wealth. So this suggests that it may be more difficult to improve year-round consumption among certain groups, and it also demonstrates that we need a better understanding of the livelihood and resource access facts ... factors that determine household food access and high quality.

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So that brings us to the second analysis where we looked at the relationship between household livestock ownership and children's consumption of animal source foods. Again for time's sake I won't fully describe this analysis, but the article was published in January in the Journal of Nutrients, so the details of our analysis and the full methods are available there. So we used data from farming households that contained a child again between the ages of 6 months and 72 months of age. And again this was data from the POSHAN sentinel surveillance sites just like the previous analysis. So this time we use negative binomial generalized estimating equations to examine the association between ownership of specific types of livestock and children's

consumption of animal source foods. So we looked at the association between cow and buffalo ownership and dairy consumption frequency, the association between chicken ownership and egg consumption frequency, and then between meat animal ownership and meat consumption frequency. And for this meat animal category we included the animals that are commonly raised for consumption in Nepal. So this included livestock like poultry, goats, and sheep, pigs and rabbits, but we did not include cows or buffalo. And finally, we were interested in examining ... we're interested in estimating the direct effect of livestock ownership on intake. So we wanted to try to adjust for any effect that might be occurring via income generation. So in each model we also included the household expenditure for the relevant food item. So we had included expenditure on either dairy, eggs or meat in the days prior to the survey.

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So these graphs again show the predicted marginal values based on the model output. So the y-axis for each here is the average times per week if children are predicted to consume each food type similar to the previous plots. And for each type of animal source food; we've plotted the relationship between the numbers of livestock owned which is the x-axis and the plots to the left and then food expenditure which is the x-axis and the plus to the right. And these variables were categorized based on their interquartile range so that's why the units and increments differ across these plots.

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So the first thing to note is that the relationship between the number of livestock owned and food consumption frequency differs quite a bit across these three plots.

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So looking at cattle ownership first this suggests that there's a fairly consistent increase in children's dairy consumption frequency as the number of cows or buffalo that the household owns increases

Next slide please when we looked at poultry ownership, we see that there is a significant increase in children's egg consumption frequency that's associated with owning one or two chickens compared to owning none, and that the relationship levels off after that. So you can see that even though the point estimates go down slightly for ownership of three to seven and then more than seven poultry the bars representing the confidence intervals here overlap so interestingly this indicates that there was no significant difference in children's egg consumption frequency among households owning more than two poultry compared to those owning just one or two.

Next slide please and finally when we look at meat animal ownership, we see that only ownership of more than seven animals is associated with an increase in children's predicted weekly meat consumption frequency and that the size of that increase is quite small. When you think about it that makes sense since unless the household owns many meat animals they're only

very occasionally going to be able to eat those animals. So we wouldn't really expect to see an association using just a seven day recall unless we were specifically sampling during the festival season say when meat is consumed more commonly. So overall, this suggests that the direct effect of meat animal ownership on children's meat consumption is limited compared to the direct effect of cattle ownership on dairy consumption and poultry ownership on egg consumption.

Next slide please and the last thing to note here is that across all three types of animal source foods as household expenditure on that food increased, so did children's consumption frequency of that food.

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So the findings from this analysis suggests first that even low levels of cattle and poultry ownership, so just a few animals are associated with increases in children's consumption of dairy and eggs. So this provides some empirical support for programs that promote small-scale livestock production, and that's something that many programs including USAID-funded programs like Swahara and Nepal have been promoting. Second we found that only the highest level of meat animal ownership was associated with an increase in children's meat intake, and even then the estimated increase was very small. So this suggests that increasing meat consumption may likely require really an emphasis on income generation in order to allow households to increase their food expenditure. And then third we observed strong associations between household expenditure and children's consumption of all three animal source foods. So this demonstrates the importance of food purchasing for children's diets and again the importance of enabling households to increase their food expenditure.

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So thanks very much for your attention today.

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I wanted to acknowledge these organizations which supported the push on community studies.

Next slide please and finally all of the individuals that contributed to the data collection and research and were part of this team. Thank you.

[Wafaie Fawzi](#)

Great thank you so much Elena. Really very interesting set of findings and I'm sure we will have a chance to discuss some of these and there are already a lot of interesting questions that we will come to. Last but not least really, delighted to hear from Andrew Thorne-Lyman. And through the floor is yours.

Andrew Thorne-Lyman

Thank you so much and thank you all for joining us. I know for many of you who are up late here in the United States this is early morning for you and we really appreciate everybody from all over the world joining this great attendance, especially for today, so thank you. So I'm going to build on the findings that Elena just presented and talk about seasonality of the minimum dietary diversity for a children indicator in three settings: Nepal, Peru and Senegal. And I would just like to begin by just thanking USAID Feed the Future Nutrition Innovation Lab for the funding to especially look at the Nepal data. And then we received funding through the data deck project from the Bill and Melinda Gates Foundation to also look at data from Peru and Senegal. And so I'm going to be presenting from three settings on three continents today

Next slide please so first a little bit of background. There have been increasing calls for indicators that are more responsive to programs than anthropometry. We know in particular although there's a lot of talk about stunting and we know that stunting is a great indicator of poverty, it's not extremely responsive especially in the short term, to nutrition programs and increasingly with programs becoming more multi-sectoral and involving agricultural components that are really aiming to try to increase the diversity of foods that are that are available and consumed by especially children and mothers, there's increasing interest in diet and foods consumption indicators. And this was really highlighted in a great review by Anna Herforth and Terry Ballard in which found that nearly 93% of projects that they that they surveyed reported on diet or food consumption indicators, and that really showed tremendous growth compared to a previous review in 2010. So these indicators are really catching on, especially in agriculture and nutrition projects. And for that reason I think it's really important not only to undertake studies that validate these indicators against nutrient adequacy, which has been done for the minimum dietary diversity for child indicator, but also to also examine some of the practical elements of the indicators. And so we know that diets in many settings are seasonal. We know that certain things like vitamin A rich fruits are extremely seasonal in certain countries, you know, mango season in Bangladesh in South Asia lasts a couple of months, and then it's gone and during that season a lot of people eat mangoes. But while we know and believe that diets are seasonal, the extent to which this indicator, the minimum dietary diversity indicator for children, is subject to seasonality remains uncertain. And so if pre-undertook a review of the different causes of child malnutrition and they published it I think last year, and in South Asia and they found that only one study had been published, and this was prior to Elena's study being published only one study from south Asia had been published looking at seasonality of child diets. And so there's a real information gap here and that's what I'm going to be presenting on today.

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Okay, so just a little bit of information about the study populations and the data sets I'm working with. Elena presented on the Poshan study of Nepal, which you know followed the same methods that she outlined. Only we're presenting on a smaller population because it's a subset of six to month olds, while she presented on six to seventy two-month-olds. We also were able to get data from Peru, the continuous DHS, which is around the year survey they collect data at

two day two points per year, and we have data from 2004 to 2016 on about 36,000 children, so quite a large data set which enabled us to look over many years at seasonal patterns in this indicator. And similarly, the Senegal continuous DHS was started a little bit after the Peru data set and so there there's not as many years, but still quite a large sample. And both of those DHS surveys were nationally representative as well.

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I'm not seeing the next slide, thank you. And so I think many of you are familiar with the dietary minim ...dietary diversity for children indicator, although for some reason some people are not aware that it has been updated, and so now breast milk has been added and now it's a an eight food group scale and the threshold has also been raised to five or more food groups. And so it includes grains, legumes, and dairy products. I'd like to highlight that flesh foods also include fish consumption not just not just terrestrial meat, eggs, pro vitamin A rich fruits and vegetables, other fruits and vegetables. And another score that we looked at was just the simple tally of all of these is a continuous variable which we called the food group score.

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And so, this is a really nice figure of the rainfall patterns in Peru that one of our collaborators Leah Lewis from Ohio State generated. And you can see here just that you know... we know that rainfall patterns are very seasonal and we use this in trying to create some seasonal contrasts.

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So here you can see the annual patterns in dietary diversity by year in Peru. You can see that there's kind of an odd outlier in 2004, but after that things remained pretty steady in terms of the prevalence of minim dietary diversity, a little bit of a dip into 2009, and then you also see on the right you can see the food group score on the right side, and it pretty much follows the same patterns although there's a tighter bound there because it's a continuous indicator.

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And here you see the patterns by month. So we have the month of the year. And then we also created as I said two seasonal contrasts, which we wanted to use in our analysis to really understand, you know, whether or not seasonality is a concern in the use of this indicator. And so you can see first the wet season which was generated using those rainfall pattern maps that Leah had done for us, and then also a lean versus non-lean season which came from the [] cropping calendars. So examining these patterns by month, which is pooled across the years, we see on the left that the prevalence of minim dietary diversity is highest in January, it falls through May and then it rises a bit through August, and then levels out around 65 percent. It's important to also note in each of these countries, the overall prevalence of this indicator. And then you see on the right side the mean foods group score follows similar patterns, but not exactly identical. So you can see in July the MDD prevalence went up, but in July for the mean food group score it went down. But overall, it's kind of a similar pattern seems to be a higher in January through March.

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Okay so on the left side you can see the figure there this is this presents the contrast between the lean and the non-lean season and then also the rainy and the non-rainy season. You can see that it's actually quite similar. The prevalence here prevalence estimate is about two percent higher for the non-lean season compared to the lean season and you can see that it's very very close for the rainy and non-rainy. So the main contrast there seems to be with a lean season. We also ran an OLS regression analysis to see whether or not these are significantly different. And these regression analyses also included MDD variable for the year of data collection, so we're adjusting for year in those. And you can see that for both indicators the MDD and the FGS... you can see that lean season was significant. But again it's not a major difference here, not as big as we had expected.

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And here, you can see sort of the breakdown of individual food groups. And it appears very similar for a lot of these food groups, you can see that it's quite constant for things like breast milk, grains, roots, and tubers, legumes, and nuts. There's a little bit of a difference in January and February for dairy products, but the score remains similar, the total score remains similar because at the same time as there's a rise in dairy products, the egg consumption for January and February looks a little bit lower. And so, I just think this is really interesting that there is remarkable stability here.

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So now turning to Senegal, here's again the maps. I think one difference between Senegal and Peru is just the agro-ecological zones. It's a much more ... it's a much more similar pattern that you see here in all parts of the country. And so, although there's a little bit of differences in the rainfall patterns for perhaps September, perhaps June and October overall, when it becomes the rainy season in August and September, it's the rainy season everywhere there.

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It's also a flatter country, you know, and that both Peru and Nepal are extremely heterogeneous in their agro-ecological zones. So this shows the annual patterns by year and you can see that it was remarkably stable again both indicators from 2013 to 2016, we saw a rise in the MDD indicator in 2017, but the mean food group score remained pretty constant in Senegal throughout all of the years.

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And here, you can see the patterns by month and I'll just give you a second to sort of digest this. The MDD prevalence overall is much lower in Senegal than it was in Peru. You can see it hovers around 10%, somewhere between 10 and perhaps 14% throughout the year. Fairly wide

confidence intervals for certain months. Those are due to... there were some data gaps you know for some of the months, just associated with the rounds of data collection. And then you can see the contrast there for wet and lean season, quite a lot of overlap there. There did appear to be a slight rise perhaps during the wet season in the prevalence of the MDD indicator, but most of the confidence intervals here overlap. You can see as expected with the main food group score, it's a very tight distribution there for the seasons, but perhaps again arise through September.

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And here you can see the analysis of the MDD prevalence by some of these seasonal contrasts, you can see significant overlap here between the different seasons. Again it's tightly bound in a range of perhaps about one to two percent. The regression analysis showed that there was no significant difference by either of these seasonal contrasts.

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And here you can see the food group consumption by month, and again here we have an average or a mean food group score of less than three, you know, throughout all of the months of the year, and you know again stability and a lot of these a lot of these food groups not a lot of variability here very constant in terms of these food groups.

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So anyway, summarizing Senegal, you know, I think we saw very little evidence of seasonality in either the MDD indicator or the food group score indicator. Now moving on to Nepal, we'd just like to refresh your memory here that in Nepal, we did three sentinel sites, one in each of the three regions of the country, much smaller sample size than the other two analyses. And also that we included all of the consenting households in these sentinel site areas that had children of eligible age. We did collect data in a slightly different way for the score and so we had -hour recall consumption of commonly consumed items in the past hours, but our breast milk recall was for the past seven days, and we just dichotomized that and treated it as if it had been a hour recall.

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And here's a summary of the sample size for each of the different rounds here and there was a little bit of ... there was some overlap you know in the children in this sample. And so that is one difference in study design as well is we had some of the same children overlapping different rounds. And also that we had three specific seasons that we sampled in: the post-monsoon season, the winter season, and rainy season. And I had an additional data point here for the rainy season that was not in Elena's presentation. And so we pooled each of these different seasons and we had at least two seasons... two of these seasons across multiple years.

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Okay and here you can see on the right the prevalence of minim dietary diversity across these different rounds with the seasons being ... similar seasons being color-coded similarly. And you can see that it actually ... you know the average estimates look quite similar, fairly wide confidence intervals because we had a fairly small sample size compared to the other samples, but a range of 38 you know, between to perhaps 43 like prevalence of minim dietary diversity for children.

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And due to the repeated observations, we used a slightly different approach for the regression analyses where we included ... we used generalized linear mixed models with a random intercept to account for that correlated observations within children, and we set up the contract to look at the lean season versus the post-harvest season which we felt would be the strongest contrast there. And we did not find any significant difference for either the MDD or the FGS.

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And so reflecting on these findings... you know... I think this was in many ways ... ran contrary to what we had expected... you know... we all think of diets especially in rural settings to be extremely seasonal, and yet we saw remarkable similarity in all of these contexts. We saw a little bit of seasonality in Peru, not that much in Senegal, and not that much in Nepal either. So I think this question of why is that the case is very interesting to sort of think about. And one thought we have is that many of the food groups, you know, that there may be some shifting within the food group and so for example that example of orange flesh fruits that I talked about earlier, well in that same category we have green leafy vegetables and so perhaps children, although they eat the fruits in when they're in season perhaps in other seasons they're also eating green leafy vegetables. So there may be some of that going on. I think especially in settings such as Senegal, you know, where we saw the average food group score was less than three there's very few children that are attaining or that are crossing that threshold of five or more food groups, and that's true even in good times. And so perhaps one reason we don't see seasonal patterns in that minim dietary diversity for child indicators because just so few of the children would ever cross that even if they have improvements in their dietary diversity scores. I think also just one limitation of this approach, although it's easy for people to ... it's easier for people to recall what they gave their children in the last hours, we know that there's that these indicators are subject to misclassified ... misclassification that is if we're trying to use them to estimate normal dietary patterns asking about the last hours may be unlikely to capture, for example meat consumption or foods that are consumed less frequently. And there also may be some random variation in the seasonal patterns by region both in Peru and Nepal as I said. Maybe there's different weather patterns that are influencing diet and perhaps some of these are offsetting each other in terms of the seasonal patterns of consumption.

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And so a couple more additional reflections here. You know I think, one really important research question is that we need to better understand what are reasonable changes in these types of indicators, what types of changes could we expect would be... could be achieved through

nutrition programs you know and I think you know common practice is to want to sample these indicators in the same season each year to try to minimize seasonal effects but perhaps that's not necessary if we have large magnitudes of change, that is if you expect to see a doubling of minimum dietary diversity prevalence as a result of a program even if you have small seasonal shifts you know, perhaps those aren't as important in light of that larger change that you might expect to see. I do think wherever possible it's important to try to collect same season data, but we know that can be challenging sometimes. You know in the Demographic and Health Surveys, although they try as much as possible to collect it in the same season, it's not always possible and sometimes we may see, you know, that the DHS is administered for three months, you know, perhaps in the spring, you know. And then five years later, perhaps it's sampled in the fall or there's an overlap there. And so you know, when we look at some of these patterns, especially national trends and these indicators, it's important to think about when within the season is that data being collected when you're trying to interpret, whether or not things are getting better or getting worse. Another thought I had is that, especially in settings such as Senegal, where you have a very low prevalence of MDD, perhaps this food group score could be a better indicator for tracking progress, you know something that uses the average food group score instead of this dichotomous indicator may be more likely to capture progress. So perhaps this is an additional tool that we need to add more regularly to our toolbox. It doesn't require collecting any additional information but I think it can add a lot of additional insights in some cases and it also has an advantage in terms of requiring smaller sample space compared with the dichotomous indicator.

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So I think as far as future priorities, these dynamics need to be explored in other settings. We saw heterogeneity in these three contexts, and I think we need to continue to build some data points, you know, as much as possible to collect data across seasons and other settings to better understand the effects of seasonality on indicators, such as this, and also on the women's dietary diversity score as well. I think it's important when we're trying to interpret things such as you know at a national level you know, I know that the global nutrition report fact sheets which are very commonly used now are now reporting on dietary indicators. It's important to think about what time in the year are those collected and to think about that in light of the seasonal patterns that are being collected. I think we also need to continue to develop other metrics in our tool box to understand patterns related to diet. Thank you. I'd like to like to just end by thanking all of our collaborators on this including in Nepal, NTAG, New Era and also the data team, and the Nutrition Innovation Lab team, and all of the co-authors on the manuscript. Thank you.

[Wafaie Fawzi](#)

Great, thank you so much Andrew for a great presentation, a number of interesting findings from the three countries, quite consistent... and for the reflections at the end. Lots of questions have come in the Q&A, very vibrant community, wonderful attendance as was noted, it's really nice to have this opportunity. We will take some questions. I hope we will take as many as we can. Broadly, there are two groups of questions that maybe we will take if I may suggest, first that will focus a little bit on the metrics: What are they and what are the next steps. And the second is on the substantive findings really that have been reported by Elena and others really around sort

of: What are the findings? What are the policy implications of these findings? And so both are obviously relevant and related but we'll take them in that order. So if I could start with the sort of question on metrics. Perhaps Isabel starting with you. A few questions have come around PDQS and MDDs. One question that has come up more than once is; why are potatoes bad? Why are tubers and roots unhealthy? So could you say a little bit more about the PDQS, a little bit more? You described it already but just recap a little bit and address that issue around foods that are noted as unhealthy.

Isabel Madzorera

Great thank you that's a really important question judging from the responses from the audience here. I think just to clarify that so we adopted the PDQS and the way the PDQS was put together, it was based on identifying foods that are associated with poor health and nutrition outcomes. So for example, we know that red meat has been associated with increased let's say cardiovascular risk and so forth so that that forms the basis of why some foods are classified as healthy, and some foods are classified as unhealthy. Same applies to... same applies I guess, when we talk about potatoes on average, the score we adopted it from a score that really did not address other forms of roots and tubers. And potatoes, we know raw potatoes are a source of carbohydrate and energy, without much more in terms of micronutrients that they contain. And we also know that here in the US, where this course was put together, they're mostly consumed as fries or chips. And so based off that they were listed as unhealthy when we ... when we tried to apply this PDQS to low and middle-income countries, we realized that in many communities there are other roots and troubles that are consumed other than potatoes. And so we combine this together and I do think that the audience raises a really important question whether some associations that we see in developed countries would still apply in low and middle-income countries? And I believe that one of those one the studies that's looking at this is the PDQS study that Professor Fauzi and others are leading, to try and disentangle how to classify foods as such. As it pertains to our study because we also worried about classifying roots and tubers and potatoes as unhealthy, we did a sensitivity analysis, where we classified this group as healthy and in another sensitivity analysis, we excluded potatoes roots and tubers, because we're also unsure how they would really match with health outcomes. And in both cases the associations that we found with pregnancy outcomes were maintained. So meaning that whether we classified potatoes was unhealthy or healthy for the overall look at and its association with pregnancy outcomes, the results and the findings are unchanged. But I think it's a question for further studies as we try to apply the PDQS in multiple locations.

Wafaie Fawzi

Great thank you Isabel. As you just briefly noted there is a large effort that's underway really towards [] and almost completed, led by [] and Harvard and colleagues, Walter Willett, Sabri Bromage, myself, and others looking at PDQS in multiple settings, invalidating that tool, coming up with a new tool that's called GDQS, Global Diet Quality Score, and validating it in Mexico, in India, in various African settings, and in the US, and China. So that's promising and hopefully in the next few weeks and months, we will see those findings out there, but leads me to ask a question really to you and to Andrew. You know, there is this metric that is evolving and advancing in many ways that talks about quality, and we have traditionally been using a lot of

MDD-w for women or MDD that Andrew has referred to for children. So what's your take Isabel, and then Andrew, on the need for both types of metrics: do we need both of them or should we focus more on quality, as it is presented where it is an element of healthy and unhealthy aspects?

Isabel Madzorera

Isabel, okay great, thanks. That's a really important and difficult question. I would hope not to answer that. But I think that broadly the two scores in my opinion have... they are complementary. I believe that for example when we talk about situations where the main limiting factor is consumption of micronutrients, then the MDD-w can perform quite as well in terms of associations with poor health or nutrition outcomes. However, I do think that increasingly diets have changed. I am Zimbabwean and I grew up in Zimbabwe, and over time every time I go home, I'm surprised by what people are eating. So there is nutrition transition, and I think that to be on top of this transition, we really, really need to be able to start tracking consumption of unhealthy foods and how they influence health outcomes. Particularly we do see in many low and middle income countries increased occurrence of diabetes, of hypertension, and many other diseases that could be diet related. So I think tracking and increasing tracking of the PDQS are related indices that look at diet quality overall beyond just diversity is quite key not just for women also for men and probably also for children and that I think it's my opinion.

Wafaie Fawzi

That's helpful Andrew your thoughts?

Andrew Thorne-Lyman

Yes I think, I think both are beneficial. You know, I think it's actually quite challenging to just have one combined metric. We know that dietary diversity correlates positively with energy intake and energy intake is, you know, is something to be concerned about you know I think we need a different metric that somehow deals with deals with that aspect of things because wealthier households have more diverse diets overall. Yeah, I mean one you just gave me one thought though you know which is you know perhaps one reason why we don't see more seasonal patterns especially in Nepal, you know is given the findings of the ARCH project you know, and just the expanding role of processed food consumption in child's diets, you know, that's not as seasonal and if children are increasingly being fed biscuits and other things rather than you know these components of dietary diversity, perhaps that's attenuating some of the seasonal patterns that we would have observed even years ago.

Wafaie Fawzi

Yes, very interesting. So a common thought really between what you and Isabel study really, it's important to collect data on diet, and then analyze it in various ways and hopefully over the next few months and years. We will learn a lot about sort of the application of dietary data in its calculation as sort of various metrics. But on that Andrew, you noted that maybe a single- 24

hour recall may be sub-optimal, and there is some specification there. So what does that mean? What are the implications of ... that really should we be doing more? Can we be doing more?

Andrew Thorne-Lyman

This is something that's been discussed a lot you know in the context of more of the quantitative hour recalls, but not as much in the context of these types of indicators, you know I think because the emphasis with the MDD-w and also the child indicator has been largely on estimating the average intake, there's not been a lot of discussion around one of the potential inherent weaknesses of it, which is if you're using the dichotomous outcome, you know then you and you're only doing one recall, in a situation where there is variability especially in the context of higher prevalence of MDD, you may be overestimating the prevalence of people with low consumption. If you take more than one measure, especially in different seasons or at different points in time that would move towards a more accurate estimate of what normal consumption looks like, and then the question becomes you know: How much additional cost is it to sample twice? Would it be possible even in a subset of households as part of the DHS to go back and sample a week later say, and to try to get another measure similar to what we do for blood pressure measurements, you know you don't want to just have one blood pressure measurement if you really want accurate estimate of blood pressure, you need to take it twice and it's the same concept with diet with the -hour recall.

Wafaie Fawzi

Yes are right and so if perhaps a sub-sample has two measurements and you can come up with a way to correct for that measurement error. That would be quite useful. Perhaps we'll see more of that... we've seen a lot of that with nutrient analysis and maybe more of that with dietary diversity and dietary quality will be useful to do. Elena if I could transition a little bit to findings that you have shared from Nepal, one question that came in the Q&A is: you've noted that animal source foods have low consumption and an interesting question is; Could that be due to cultural or religious reasons? How do you sort of factor in these social determinants?

Elena Broaddus

Yeah, I think that definitely plays a role and we ...that's one of the reasons why we did examine caste and ethnicity. And so I think our findings suggest that there definitely is variation by caste and ethnicity, and you know different these different groups have different social traditions around food. I think our findings though also suggests a really important role for economic factors and spending capacity, you know, capacity for households to purchase food. And so I think, you know, I think it's important to consider the role that that food traditions can play but I think the economic factors play a very large role.

Wafaie Fawzi

That's a good point, so sort of that leads to some thinking, a little bit about solutions and implications of the findings that you have. But before we get to that and we are running out of

time, but still it's an important area, another observation from the audience is that there tended to be highest consumption of certain foods in the monsoon as opposed to the post-monsoon, and there was a question from one person, and more than one really: to what extent there are efforts to preserve or dry or other means of refrigeration etc. for these foods? Any thoughts of how that might be playing a role and then maybe transitioning from there to broader implications really of your findings to policy and programs: how do we increase access to these aspects of these foods in the setting of Nepal?

Elena Broaddus

Yeah so as far as the preservation question, that's not something we can really look at unfortunately with this data since we didn't ask about fresh versus preserved foods. I think if we're talking about vitamin A rich fruit and vegetable consumption being higher in the monsoon period and that's one of the things we saw in the months, you know anecdotally, I think that it during the rainy season there is more capacity to grow leafy greens and other fruits and vegetables. So I think, when we see that increase I think that may be more to due to the increased capacity for household production of these foods during that season. I think but I do think that preservation definitely could contribute to some of the decrease you know that that may be attenuating seasonal differences that we see and that's not really something we can dig into too much with this data, but I think it would be an interesting question to explore further. Let's see what the other questions were. As far as program and policy implications, I think programmatically, you know, there's a lot of emphasis within integrated nutrition programs right now I'm promoting small scale livestock productions, so encouraging households to raise small numbers of chickens, goats, cattle providing technical support and resources to encourage households to do this. And so I think... think it's important to note that our data was observational. We did not look at households that hadn't been involved in these programs versus households that had not.. We just looked at household ownership across the board and so I think I do think our findings suggest that when households do have a small number of cattle or poultry, it does indicate that that can provide some benefits to childbirth consumption of animal source foods, and so I think that does provide some support for programs that take this small scale livestock production approach. I think our findings also demonstrate the importance of enabling households to increase their expenditure on these foods as well especially in the case of meat. And so I think that really speaks to the importance of income generation components in integrated nutrition programs and then more broadly just seeking to elevate the economic status of households.

Wafaie Fawzi

That's great. There are many other interesting questions and perhaps we won't be able to get to all of them. I'd like to sort of in the last two minutes that we have asked each of the three panelists to just end with their own one point in 30 seconds. What is your sort of take away from the work that you have done or others in this that would be really important for us to consider as we advance in this element of nutrition agriculture and health integration? Maybe starting with

you Isabel. I know you have each one of you would have many points but just pick one that would be helpful.

Isabel Madzorera

Great, I think the main takeaway point for me is really moving towards thinking about diet quality more broadly in all locations, because of nutrition transition and take along with that when we talk about nutrition and agriculture thinking about the role of women's empowerment as well as access to markets and distance to markets. How we can improve that and I feel that those are all key to addressing nutrition challenges in agricultural communities.

Wafaie Fawzi

Thank you so much Isabel, Elena?

Elena Broaddus

I think my takeaway is just the importance of striking a balance between broader aggregate indicators and then more detailed disaggregated indicators in terms of you know the resources needed to obtain this data but then the additional information that deeper metadata can give you and I think similarly the need to strike a balance between broad strategies that can be implemented in multiple locations and very context-specific, context-tailored approaches.

Wafaie Fawzi

Excellent, Andrew?

Andrew Thorne-Lyman

Yes you know I think these dietary diversity indicators are great. I think they're extremely responsive and promising. I guess my thought would be to where possible where projects are trying to monitor changes in diet, don't limit yourself to these indicators, though I think you know, if you're doing a homestead gardening project, yes collect the dietary diversity indicators, so that you can report on it and understand it, but also collect data on the specific foods that you're promoting to try to measure that specifically, you know. Don't limit yourself to these indicators, because the more you collect the more chance you have to show you know that your project is working.

Wafaie Fawzi

Thank you so much Andrew, Elena, and Isabel. It has been a very vibrant webinar. Thanks to the audience. I would end on one point that was noted by our colleague who attended Ruth Webster that highlights the importance of sort of thinking about these are really multiple sectors and very much interrelated. So, he recommends that we move beyond nutrition-sensitive agriculture to

nutrition-sensitive food systems and all the elements that really are at play in a food system are important, from production to consumption to intra household distribution to you know the role of processing, distribution and transport, elements handling and so this it is a complex area but it is also a very vibrant field and delighted that we have such a wide network of colleagues around the world who are interested in partnering with us on this. So looking forward to more work in the months and years to come and for now wishing you all the best stay safe and stay home. Bye.



USAID ADVANCING NUTRITION

Implemented by:
JSI Research & Training Institute, Inc.
2733 Crystal Drive
4th Floor
Arlington, VA 22202

Phone: 703-528-7474
Email: info@advancingnutrition.org
Web: advancingnutrition.org

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This document was produced for the U. S. Agency for International Development. It was prepared under the terms of contract 7200AA18C00070 awarded to JSI Research & Training Institute, Inc. The contents are the responsibility of JSI and do not necessarily reflect the views of USAID or the U.S. Government.