Improving Diets Through Innovative Data Analysis and Modeling of Food Fortification: Evidence from Malawi

Webinar Transcript

Yaritza Rodriguez

Hello everyone. Good evening, good afternoon, good morning. Welcome and thank you for joining today's webinar on Improving Diets through Innovative Data Analysis and Modeling of Food Fortification: Evidence from Malawi. Before we get started, I will review the zoom environment for today's webinar.

Next slide please.

First, if you are unable to hear, please make sure you connected your audio by selecting the headphones icon in your zoom control bar. Today, please send a chat message to all panelists and attendees to introduce yourself, send in your comments, or ask for tech support. It's important you send that message to all panelists and attendees so we can all see the messages that you are sending, especially since we may not be able to see each other's names in terms of the participant list, so it would be great to have you introduce yourselves in that chat box. If you are unable to hear the presenters or see the presentation at any point during today's webinar, please try leaving the meeting and joining it again via the link sent to you in your registration confirmation email or in the reminder email you received this morning earlier today. Tech support can also be requested by contacting me at yaritza_rodriguez@jsi.com. I'm a Project Officer with USAID Advancing Nutrition and I'll be supporting today's webinar so please feel free to reach out if you need any tech support. Please, also note that this webinar is being recorded.

Next slide please.

Please use the Q&A feature to send in your questions for panelists. Panelists will be answering questions during the moderated Q&A portion of the webinar. To ask a question, please type the question into the space provided in the Q&A box and then click 'send'. Finally please note that your experience today may vary based on your internet connection and computer equipment.

Next slide please.

Today's webinar will be moderated by Jennifer Yourkavitch. After introductory remarks, we will have a presentation followed by a panel discussion and then some moderated questions and answers. I would now like to introduce our moderator, Jennifer Yourkavitch. Dr. Yourkavitch is the Director of Monitoring Evaluation and Learning at USAID Advancing Nutrition. She leads and provides strategic direction to a broad range of activities in the USAID Advancing Nutrition portfolio that focuses on or involves key aspects of monitoring, evaluation and learning. Jennifer has been supporting USAID Advancing Nutrition's work on the Malawi integrated household survey analysis and fortification modeling, which will be presented today. Thank you so much for moderating our session today Jennifer, now over to you.

Jennifer Yourkavitch

Thank you Yaritza, welcome everyone and thank you for joining this webinar today. As Yaritza mentioned, I have been supporting the USAID Advancing Nutrition work on using household consumption and expenditure survey data, also called HCES, to estimate food and nutrient intakes, nutrient inadequacy, and model fortification scenarios. For the past year, we have been collaborating with the Micronutrient Action Policy Support project (MAPS) which is funded through the Bill and Melinda Gates Foundation and is co-creating a web-based tool to estimate micronutrient inadequacies, and also explore pathways to improve nutrition. USAID is supporting an analysis of the use of HCES data to make inferences regarding the micronutrient adequacy of diets, and the potential contributions of fortification. And this is important because lack of national and particularly sub-national food consumption data is an obstacle that prevents the development of evidence-based policies

and programs, that can help fill population level micronutrient gaps. Although estimating the burden of micronutrient under nutrition requires the combination of data types, dietary data play an important role in identifying populations with the greatest needs. As we will learn from Kevin today, household consumption and expenditure surveys, also known as Living Standards Measurement Studies or LSMS are routinely conducted every three to five years in many low and middle income countries, and can potentially provide proxy measures for food consumption and nutrient adequacies through secondary analyses of the data at low cost and in a short period of time. During the session today Kevin Tang will share results from his analysis of the Malawi integrated household survey from 2016 and 2017, and his modeling of dietary micronutrient supply and fortification scenarios. I think you'll find these analyses very interesting and informative.

Next slide please.

And now it's my great pleasure to introduce you to our speaker Kevin Tang. He is a PhD candidate in Epidemiology and Population Health at the London School of Hygiene and Tropical Medicine where he contributes to computational research that combines epidemiological, econometric and geo-statistical methods to understand food system drivers of undernutrition. His areas of expertise include micronutrient under nutrition, nutrition equity, mathematical modeling, dietary assessment, large-scale household surveys and food fortification. He has worked as an epidemiologist with doctors without borders in the Democratic Republic of Congo and Niger, and served as a Peace Corps volunteer in Cameroon. Kevin, thank you again for taking the time to present to us today and now I'll turn it over to you.

Kevin Tang

Great. Thanks Jennifer for that great introduction and hello everybody. Thank you for having me today. It's a pleasure to be here. I want to thank USAID Advancing Nutrition for hosting this webinar and for supporting this work alongside the Bill and Melinda Gates Foundation. My name is Kevin Tang and I'm a PhD student in the Faculty of Epidemiology and Population

Health at the London School of Health and Tropical Medicine where I work alongside the MAPS project as Jennifer explained.

Today, I will present a conceptual framework that I've been working on for the past year that uses widely available economic survey data to gain insights into risks for micronutrient deficiencies at subnational scales, and the potential contributions of nationally implemented micronutrient interventions can have in mitigating risks for micronutrient deficiencies. With large-scale food fortification, and Malawi being used as a case example. Now I think Jennifer did a great job introducing the topic and setting the scene, so as I walk through this case example, I encourage those watching who are working in micronutrient nutrition to think about how this mathematical framework can be applied to measure the potential contributions of other micronutrient interventions outside of large scale pre-fortifications, and from other country contexts where this style of data exists.

To start, the global approach to estimating and understanding burdens of micronutrient under nutrition requires a combination of data types describing the entire continuum of micronutrient under nutrition. Dietary data plays an essential role in identifying populations that are potentially at risk due to inadequate diets, and predicting the potential contributions of individual intervention. Poor quality diets are the main cause of micronutrient deficiencies; where individuals consume inadequate quantities of bioavailable micronutrients to meet the physiological requirements. Now there are several dietary assessment methods that are available and each results in a different kind of data.

So, Household Consumption and Expenditure Surveys or HCES is a type of survey that collects a particular style of dietary data. HCES are a family of nationally representative multi-component economic surveys which provide data to describe and characterize an array of systemic conditions. HCES questionnaires are designed by each country's National Statistics Office and therefore vary substantially between countries. However, the food consumption data are similar in that they recall foods consumed by the household over a fixed period. They used a pre-defined food item list to guide the recall which may or may not include food eaten away from home, and they collect information on consumption quantity costs and origins of the food. It's important to note that these characteristics results in a fair amount

of imprecision in the recall. So as a result, the foods and micronutrient quantities are defined as being apparently consumed or the apparent intake of micronutrients.

In collaboration with the World Bank's LSMS program, the National Statistics Office of Malawi has been implementing regular HCES surveys which they call Integrated Household Surveys, approximately every five years since 1997. From these data, researchers can generate knowledge about diets in Malawi. For example, according to this study led by IPRI in Malawi, energy macro and micronutrient supply from foods come from … Micronutrient dense foods like animal-based products are not consumed in high quantities, and vegetables, fruits and root tubers play a role but are likely to be affected by seasonality.

Another source for micronutrients comes from large-scale industrial food fortification. According to Malawian national policy, there are a few foods that require fortification with different micronutrients. This includes oil and sugar which are both fortified with Vitamin A, wheat, maize flour which are both fortified with a number of different Vitamin And mineral micronutrients, and salt which is fortified with iodine. So these interventions are implemented at the industry level. So one might question how well can these interventions contribute to reaching populations that need them. To predict the contributions of these programs in improving an adequate diet … One second. I'm going to turn my video off just so I can … here we go.

So, to predict the contribution of these programs to improving inadequate diets, we can build mathematical models estimating household micronutrient supply with an example shown here on the right using HCES data from Zambia. These models require combining two types of data: that's food consumption data from HCES and food composition data from national and regional micronutrient composition databases. So there's strong precedent for the uses of these kinds of models to inform micronutrient policies.

One might ask how strong? Well during the first year of my PhD, I conducted a systematic review of all studies using HCES data to model micronutrient or energy supply, where I identified 61 studies that applied these methods. The aims and application of these 61 studies varied greatly but the main point that I want to emphasize here is that, there has been

substantial research effort in the research community over the past two decades to understand how to best leverage HCES data for insight into the micronutrient profile population. So using the information available to us, now is the time to conceptualize how to best apply these methods to encourage data-driven decision-making to guide micronutrient interventions. As a case example on the insights that can be drawn from HCES modeling analyses, this study aimed to estimate the potential contributions of industrially fortified oil, sugar and wheat flour towards meeting dietary micronutrient requirements in Malawi using this mathematical modeling framework. So salt will not be included in this study as it is a bit more difficult to model. But we are currently conducting that analysis in a separate study. And maize flour will also not be included in this study.

Sentinel site data of fortified foods conducted in 2019 by the Malawian Ministry of Health and Population reported that only ten percent of maize flour samples that were collected were fortified. Maize flour is predominantly grown and milled at small medium scales in Malawi rather than produced at industrial scales. So for these reasons, we didn't include maize flour fortification in this study.

We have three objectives.

- The first is to estimate the coverage and apparent consumption quantity of each fortification vehicle; the second is to predict the contribution of fortification on the prevalence of inadequate dietary quality; and the third is to identify differences in micronutrient density and apparent intake in urban and rural residences, between socio-economic positions and between districts. So let's jump into some of our methods. First we'll look at the base data that serves as the foundation of our model. For the food consumption data component of the base model, we'll use Malawi's fourth integrated household survey or IHS4. IHS4 was implemented nationally between April 2016 and April 2017. Two-stage sampling divided the country into 780 enumeration areas with 15 households representing each area. Aggregation resulted in a total sample size of 12 447 households. In terms of the food consumption module, the food item list consisted of 156 pre-defined food items which is comparatively high compared to other countries. Recall was conducted for the entire household for the last seven days.

For this food composition data, we referred predominantly to the Malawian food composition table. So all the micronutrients found in the fortificate mix for wheat flour were included in this analysis as listed here. Energy was also included as it was necessary for one of our metrics, and if there were any missing micronutrient composition values for any of the food items, we look to other published food composition tables from neighboring countries or as a last resort from broader regional databases.

So next we'll look at our fortification scenarios. We will have three different fortification scenarios which we will compare against one another. The rows in the table below indicate a different food fortification vehicle and the columns represent the micronutrient composition values for the three different scenarios. So I presented the parameters for Vitamin A for the oil and sugar analysis and then Zinc as one of the micronutrients found in wheat flour. Parameters of other micronutrients found in wheat flour demonstrate similar patterns between fortification scenarios as Zinc does. So the first scenario assumes no fortification of any of the products as our base case. So you'll see here that wheat has naturally occurring Zinc which is why the composition value is not zero. The second scenario represents the current fortification status quo where industries are fortifying products but at levels which do not meet current standards set in place by national policies. These composition values were derived using food vehicle samples collected from sentinel sites in markets throughout Malawi by government regulatory bodies. And the third scenario represents a hypothetical where industries improve compliance to meet government refortification standards. These values assume a higher micronutrient composition in each food vehicle to meet fortification standards at production, and account for fortificate deterioration during the time between production at the factory and preparation for consumption at the household.

So next we'll look at the metrics to predict contributions. Before describing the metrics used for this analysis, first I want to walk you through the Adult Female Equivalent or AFE concept. With food consumption data collected at the household level, one common approach to transforming this style of dietary data into a usable metric is to individualize the total household supply of food, by assuming how the food is distributed amongst household

members. AFE assumes that the distribution of food between members of the household is proportional to the energy requirements of each household member. Factor values are derived for each household member where the adult female serves as the reference for one AFE, her male partner who has a higher energy requirement is assumed to consume a larger portion and be of more AFEs, and finally her children who have lower energy requirements and are assumed to consume smaller portions and be of less AFEs. All household AFEs are summed to get the household total. There are two categories of metrics to predict program contributions: those that assess the fortification vehicle and those that predict the overall fortification program contributions in relation to the additional contributions from foods. So I'll be explaining each metric using this dinner plate which represents the family's meal.

So first to assess the fortification vehicle, the first metric is vehicle coverage or more simply is the food vehicle on the plate or is it not. The second metric is vehicle apparent consumption quantity or how much of the food vehicle is being consumed? Is it a little bit or a lot. Quantities consumed by the household will be estimated per adult female equivalent or again a method that distributes the food vehicle within the household in proportion to each individual's energy requirement. For metrics to predict program contributions, we need to take a look at the total micronutrient contributions from the entire meal. So the first of this metrics is micronutrient density. This is calculated by estimating the sum of the household's total micronutrient supply, estimating the sum of the household total energy supply, and then calculating the ratio between the two. This metric provides insight into the quality of the diet or in layman's term, for every bite of food how much micronutrient does an individual get. Populations with lower micronutrient density require more bites of food and to meet the same micronutrient intake as populations with higher micronutrient densities. And finally the last metric is the apparent intake or the quantity of the household micronutrient supply. This is calculated by estimating the sum of the household total micronutrient supply as before, then reported per adult female equivalent. So in layman's term, assuming the plate of food is finished, how much of a micronutrient is consumed by an individual.

So finally we'll look at the subpopulation disaggregation to evaluate equity implications. Results will always be presented first at the national level with all 12 447 households. Results will then be stratified into the three administrative regions of Malawi: North, Central and South. Next results will be stratified by urban and rural households as these two populations will likely have differences in food systems and accessibility considerations. And finally, urban and rural households will be divided within their samples into five socioeconomic quintiles based on the total inflation and adjusted annual household expenditures per capita, which is a standard measure of wealth. We do this because rural households of lower socio-economic position are likely to have very different living standards conditions compared to urban households with low socio-economic position. So it's important to evaluate these two populations separately. So this is supported by evidence from this table which identifies differences in characteristics between these groups. There's a lot going on on this table. So I just wanted to highlight that rural household with low socio-economic position are more likely to be farmers, live further away from roads, will have lower educational attainment for both men and women, will depend more on social safety net programs like cash transfers and food assistance programs, and are more likely to have a child in the household with under nutrition divided anthropometrically by either wasting, stunting or underweight.

So as we review results disaggregated by different socio-economic conditions, it's important that we understand how these characteristics may affect their diets. So for the first objective, we'll look at the coverage and apparent consumption quantity of each food vehicle. In terms of coverage nationally, all three food vehicles had high coverage. Oil had the highest coverage with 76 percent of households consuming any quantity of it. And sugar and wheat flour both were consumed by approximately half of the population. When disaggregated by region, we found no substantial variation between regions for all three food vehicles, and when comparing urban versus rural coverage for all three food vehicles, urban households demonstrated higher coverage compared to rural households. For oil and sugar, coverage in urban areas was practically universal. When separating rural households by socio-economic position for all three food vehicles, coverage was lowest in populations with low socio-economic position. Coverage increased as socio-economic position increased. And sugar and

wheat flour had exceptionally low coverage in populations of low socio-economic position. For urban socio-economic position stratification, oil and sugar maintain near universal coverage across all socio-economic positions. Wheat flour demonstrated a similar increasing trend in coverage as socio-economic position increased. In terms of apparent consumption quantity among consumers nationally, median oil and sugar apparent consumption was 12 and 28 grams per day per AFE. Medium wheat flour apparent consumption was 9 grams per day for AFE which is approximately one pound full of flour. Similar to coverage, there is no noticeable difference between administrative regions for all free food vehicles. And also similar to coverage, when comparing urban versus rural quantity consumed for all three food vehicles, urban households demonstrated higher median apparent consumption quantity compared to rural households. For wheat flour, in rural residences, median quantity of consumption was so low that it was practically none. And for all three food vehicles in both rural and urban residences, there was an increasing trend in apparent consumption quantity as socio-economic position increased.

So next we'll look at the second objective which is to predict the contributions of fortification on the prevalence of an adequate dietary quality. To assess inadequacy at the national level, we'll be using these percentile curves. From the y-axis is micronutrient density as a continuous variable. On the x-axis is the percentile of the population. So you can imagine these curves by taking all 12 447 households arranging them from lowest density to highest density, then plotting them on this plane which will end up in a curve. The dotted red line is the threshold for adequacy or the critical nutrient density. This is defined as a micronutrient's daily average requirement divided by the mean daily energy requirement. The parts of the population that exceed this threshold or the section of the curve that enters green area is considered to have adequate micronutrient density, and those below the threshold in this red section are considered to have inadequate micronutrient density. Finally, the intersection of the curve and the threshold of inadequacy on the x-axis is the population prevalence of inadequacy. So under the “No fortification scenario”, 77% of the population is defined as having inadequate Vitamin A density. Under the “Status quo scenario”, inadequacy drops to

50%. And finally under the "Improved compliance scenario", inadequacy drops further to 37%.

So for Zinc, our example of a micro nutrient fortified only using wheat flour, we see very little separation between the three curves and practically no change in the prevalence and adequacy suggesting low potential contributions of a micronutrient fortified by wheat flour alone. And here are the other percentile curves for micronutrients fortified by only wheat flour. Between the three scenarios, we see very little difference suggesting that wheat flour fortification has low contributions overall in reducing dietary inadequacy for all micronutrients in Malawi. The prevalence of inadequacy is above 60% for six micronutrients under the improved compliance scenario. That's for Riboflavin, Niacin, Vitamin B12, Iron and Zinc.

Finally the third objective will disaggregate our subpopulation. So first we'll look at the total populations. So on the y-axis here we have the Vitamin A density of the diet, on the x-axis we have the date the survey was done at the household. The green line indicates the Vitamin A supply assuming no fortification, the solid black line the status quo fortification scenario, and the dotted black line the improved compliance scenario. The colored line on the bottom represents the Vitamin A contributions from each fortification vehicle. So here we see across the entire population that there is seasonality in Vitamin A supply due to contributions from food in the diet. Particularly from green leafy vegetables. When we account for the status quo fortification, Vitamin A supply is increased throughout the entire year and meets adequate densities except in the low season in January and February. If compliance and industry standards were met, Vitamin A density would be sufficient for the entire year, even during periods of low supply.

Here we disaggregate by urban, rural and socio-economic position where each facet represents the seasonality plot for a different subgroup. We see that Vitamin A from foods or the No fortification scenario green line is relatively consistent for all subgroups suggesting that all subgroups have similar Vitamin A dietary quality. Since only urban populations and rural populations of high socio-economic position are consuming oil, sugar and wheat flour, in adequate quantities, only they receive Vitamin A boost from fortification. And the rural

populations of low socio-economic positions do not receive a large enough boost from fortification to improve their dietary quality to meet the requirements even during the low season. So when looking at the apparent intake or the quantity of Vitamin A supply in the household, the green line suggests that rural populations of low socio-economic positions start with lower apparent intake from food compared to urban and wealthier populations. However, as previously shown in the density figures, food fortification does not adequately reach these populations and their total Vitamin A supply under both fortification scenarios remains under the adequacy special for the entire year.

So this map shows the district level prevalence of Vitamin A inadequacy using the nutrient density approach. The A, B and C panels represent the three fortification scenarios and the progression from A to C shows the predicted contributions as food fortification improved and compliance at industry level. In the Vitamin A density example, we see high prevalence of inadequacy across the entire nation under the No fortification scenario. As we account for the contributions of fortification, we see that the map lightens across the whole country indicating a decrease in the prevalence of inadequacy as fortification is implemented. Urban areas or the yellow dots in each of the regions in the B and C panel seem to benefit the most from Vitamin A fortification. We can see clearly districts that the fortification of oil and sugar will just not reach, as shown by the darker blue district in the improved compliance panel.

Here we see the same Vitamin A maps except this time using the apparent intake approach to estimate the prevalence of adequacy. With apparent intakes, we have to take into consideration not only the consumption but the composition of the diet, but also how much food is being consumed overall. So for example, some households may have low or inadequate Vitamin A density, but if they consume large enough quantities of that low-density food, they will meet their apparent intake adequacy threshold, while at the same time also greatly exceeding their energy intake thresholds. When toggling between the two maps, we see slight differences once we start to account for the total quantity of foods consumed.

So Zinc is our example of a micronutrient fortified by only wheat flour. Nationally, we see that there's very little variation across seasons since zinc in Malawi is predominantly sourced

from cereals which is consumed consistently across the year. We see little difference between the three fortification scenarios as there's very little contribution from wheat flour as shown by the purple line. When broken down by urban, rural and socio-economic position, we see Zinc density of the diet is relatively similar between all subgroups, and all or below the adequacy threshold throughout the entire year. Contributions of zinc from wheat flour is practically zero for all rural households, where in urban households there's only marginal contributions in households of highest socio-economic position.

So when looking at apparent intake or again the quantity of zinc supply in the household, we see that both rural and urban households … those of lowest socio-economic position have lower apparent intake compared to households of higher socio-economic position. Considering that zinc density is the same across the entire population, this finding suggests that populations of low socio-economic positions just have less food overall when compared to those of higher socio-economic position. In terms of the potential effect of the fortification of wheat flour, we see almost no effect in the entire rural population, and in urban populations, we see that the boost in zinc supply is only present in the population of high socio-economic position.

Here is the next map showing the disc level prevalence of zinc inadequacy using the nutrient density approach. So zinc has low contributions from fortifications. So the three fortification scenarios are almost identical. And here are the same zinc maps, except this time using apparent intake approach to estimate the prevalence of inadequacy, or again accounting for the total amount of foods consumed. From these maps, prevalence of inadequacy is even more similar across geographies, but generally remain pretty high across the board. The predominant source for zinc from the diet in Malawi is coming from cereals, which demonstrates similar consumption patterns across all geographies within the country. But stratifying inadequacy by rural, urban and socio-economic position provides a bit more information. So this table compares zinc inadequacy between the two metrics across the three fortification scenarios, where the darker shades indicates a higher level. And urban and wealthier demographics have poor zinc … like positions where wealthier and … these are cereals. So while the density is consistently poor across the entire population because

the urban wealthy groups are consuming more bites of food, they're able to satisfy their parent intake requirements. These differences are super important but not represented well by district level maps. For zinc, inadequacy is high across all geographies, and programs must develop strategies to reach the poorest population within districts in order to alleviate burdens of zinc adequacy.

So what does this all mean? The first question to address is how much does the overall Vitamin A fortification strategy in Malawi contribute to diet. Current levels of Vitamin A fortification in oil and sugar can reduce the prevalence of Vitamin A inadequacy. For oil and sugar, wide coverage and consistent consumption throughout the entire year make them good candidates as micronutrient delivery vehicles. There's potential for improvement if fortification levels increase for compliance to industry standards. Improved industry compliance doesn't just happen though. This will require investment and improved government regulatory monitoring, potentially subsidies to producers for internal product quality control and reporting, and fortified product labeling to improve feasibility of spot checks throughout the food value chain. There are equity considerations as fortification is less effective in rural populations with low socio-economic positions. There remains a Vitamin A gap that industrial fortification will just not reach. So to reach these groups we will still depend on other micronutrient interventions that can specifically target these groups.

So our second question to address is how much can a fortification program that only uses wheat flour as a delivery vehicle contribute to dietary micronutrients in Malawi? There's little effects of wheat flour fortification as a sole intervention to reducing the prevalence of inadequacy for all micronutrients in Malawi. Consumption is dominated by urban populations of high socio-economic position. Increasing fortification of wheat flour to improve compliance levels will have little effect since wheat flour products are just not consumed in large quantities in Malawi outside of urban populations of high socio-economic positions.

The Malawian government and research community has explored a number of micronutrient interventions to increase the micronutrient supply in the food system. Modeling studies like the one I have just presented can help identify gaps in current strategies, and point to

complementary interventions that might be required to meet the micronutrient needs for the most vulnerable populations. Further work on the cost and cost effectiveness of alternative micro nutrition interventions can help provide policymakers in Malawi with evidence-based information to help guide the selection of the portfolio of effective and cost effective interventions. So the best way to do this is to select a micronutrient of interest, weigh out all potential options for interventions, and compare strategies. For example, in our vitamin A example, it would be prudent to ask 'what are the potential limits to fortification?' It's continuing the oil and sugar program and filling these gaps by introducing a regulatory framework and continuing high-dose supplementation of rural children more or less cost effective than implementing and scaling up the production and promotion of Vitamin A bio-fortified orange maize. The MAPS project is currently working with our team of developers to integrate this kind of data and analysis into the tool function which I believe will be hugely helpful to decision makers to help inform policy.

So what do these results mean in relation to the biomarker analyses conducted as part of the most recent micronutrient survey?

In Malawi the most recent micronutrient survey indicated a low prevalence of Vitamin A and iron deficiency. Our model predicted that about half of households had inadequate dietary supply of Vitamin A, particularly rural and poor populations. It is important to recognize the nuances of these two data systems and how we can use data from both to inform the broader micronutrient narrative within a country. For example, our dietary supply model did not take into account Vitamin A contributions from high dose supplementation, but the most recent MNS reported that 67% of children 86 to 59 months received a high-dose Vitamin A supplement within the past six months. To measure the population prevalence of a micronutrient deficiency, we will always depend on micronutrient surveys to collect biological samples and to access biomarkers. For our mathematical models, using HCES data can help inform the design and interpretation of future micronutrient surveys.

So this study did have limitations. First micronutrient composition of food items is assumed to be consistent across all households and sensitivity to these input parameters needs exploring. One study done in Malawi found that Vitamin A fortification in oil deteriorates as

the food product moves through the supply chain. Another study in Malawi reported sub-national variation in mineral micronutrient composition staple crops across spatial scales due to soil properties and other environmental factors. So other MAPS research is currently underway looking into how this will affect our results. The MAPS tool will have features to modify what we call pre-baked models, using data brought by the user. This research does show that variation in food composition sub-naturally has a large impact. These bring your own data features in the tool will be especially important to develop new models integrating these data on the fly.

Second our model could not isolate the prevalence of inadequacy for demographics within the household, particularly for children under five and women of reproductive age. HCES questionnaires collect food consumption data at the household level. Meaning that quantities consumed by individuals within the household rely on a number of assumptions on how the food is distributed. Conclusions for these subpopulations will continue to require individual level data, from individual dietary assessment and micronutrients biomarker assessment.

And finally, there are certainly limitations in the food consumption data itself that leads to additional error. We have a very good working relationship with our partners at the World Bank's Living Standards and Measurement Study who are responsible for providing technical support to national governments and implemented their surveys. They're very interested into research to improve survey methods, to improve quality and usability of household food consumption data, and our team happily sees our perspective as modelers into their discussions. So thank you all so far for taking part. If there are any specific questions, I've included my email address here so feel free to drop me a line. I am excited now to open discussions to our panel where I hope we can answer some questions and spark some conversation about this approach. But to also discuss potential opportunities that we can explore moving forward. So I will hand it back off to Jennifer to introduce the next part of this webinar.

Jennifer Yourkavitch

Great, thank you so much Kevin for that excellent presentation. We can really appreciate through your clear visuals, the analysis that you performed with HCES data, and your findings showing the contribution of the various fortification strategies on different populations within Malawi. So thanks so much.

Next slide please.

For the next portion of our webinar, we have a panel to reflect on these findings. All of our panelists have been involved in this work as advisors or collaborators including Louise Ander who leads the MAPS project and is based at the School of Biosciences at the University of Nottingham in the United Kingdom. Dr. Ander has a background in managing and combining environmental spatial data sets to understand links between the environment and nutrition, with a specialization in geochemical data. Her research includes long-standing partnerships with colleagues in Malawi including Dr. Alexander Kalimbira, another one of our panelists today, with whom she investigates mineral micronutrient deficiencies. She is also a geochemist in the Center for Environmental Geochemistry at the British Geological Survey in the United Kingdom.

Omar Dary serves as a nutrition science specialist in the Bureau for Global Health at the U.S Agency for International Development. Dr. Dary has worked in public health nutrition from basic research to strategic planning at national and global levels. His major areas of expertise are micronutrient assessment and food fortification, and he has been involved in food analysis, nutrition surveillance, food and nutrient intakes and biomarker interpretation, for the design, Implementation, monitoring and evaluation of specific nutritional interventions. He has been an advisor to many international organizations such as WHO, UNICEF, WFP and FAO, and has provided technical assistance to more than 45 countries. He is a current or past member of several international consultative groups for micronutrient nutrition.

Alexander Kalimbira is an associate professor and head of the Department of Human Nutrition and Health at Lilongwe University of Agriculture and Natural Resources, also called LUANAR. His research mainly focuses on child growth, adolescent nutrition, micronutrient nutrition, and diet-related non-communicable diseases, with particular

emphasis on determinants and behavior change issues in the Malawian context. Dr. Kalimbira is the LUANAR lead for the MAPS project in Malawi.

Gareth Osman is a human nutritionist and family scientist with a special interest in improving child and maternal nutrition. As a specialist in human nutrition, he has extensive experience in program implementation, and monitoring and evaluation, as well as competencies in dietary assessments, nutrition status assessments, nutrition education and food analysis. He is also proficient in multiple analytical software packages. Mr. Osman is currently a nutritionist at Lilongwe University of Agriculture and Natural Resources, Department of Human Nutrition and Health where he is working on the MAPS project. He is integrating and analyzing HCES data, landscaping biomarker data, and co-designing the MAPS tool. And now over to you Louise.

Louise Ander

Thank you so much Jennifer. It's a pleasure to be with you all today and thank you to Kevin for a fantastic talk. Yes, I'm Louise Ander. I'm from the School of Biosciences at the University of Nottingham, and the overall lead of the MAPS project. The project name MAPS stands for Micronutrient Action Policy Support and we are funded by the Bill and Melinda Gates Foundation. The MAPS project is building an open access web deliver tool which allows users to explore estimates of micronutrient deficiencies at a sub-national scale, and then to take these estimates forward into functionality. Which allows the effectiveness and cost of interventions to be compared. You can find our project page at []. So we are an interdisciplinary team. We have got a real blend of technical skills in the project. These include human nutrition, agriculture, economics, spatial data statistical analyses, all of which we need in order to populate the tool. But we've also got a specialists in data architecture, scripting, coding of processes when they're within a web delivered tool, and the web development - the front-end team themselves, all of whom we also need in order to build this functionality and allow it to be accessible.

Our functionality will include a bring-your-own data capability. So you will be able to bring your own data sets which are in a common type of data set to those which are hosted within

the tool. The team is drawn from seven organizations. So on this school we've seen Kevin and he's part of the team at London School of Hygiene and Tropical Medicine, there is myself and my colleagues at the University of Nottingham, and also Lilongwe University of Agriculture and Natural Resources, and you will hear from Alexander and Gareth very soon. In addition, we have Addis Ababa University from Ethiopia, the University of California Davis from the USA, colleagues at IFPRI who are based in the USA and in Johannesburg in South Africa, and also the British Geological Survey in the UK. Our geography of interest for the MAPS project is Sub-Saharan Africa, but we have deep dive if you like really detailed data exploration activities focused in Ethiopia, Malawi and also Burkina Faso, although we have got other national teams that we're in touch with as well from other nations in Sub-Saharan Africa. Our initial assessments of micronutrient deficiencies are generated either from proxies of diet, and Kevin has shown an excellent example of that, or from micronutrient survey biomarker data. These are visualized at sub national scale. We then use the IFPRI impact model projections to place the diet proxy data in the context of expected trends in food and therefore nutrient availability under alternative future scenarios out to the year 2050. And these alternative future scenarios include all sorts of different climate change models for instance and the impact they may have on all our features. Kevin's work provides an excellent example of some of the functions which will be enabled within school, particularly initial estimates, of the micronutrients in their diet which can be taken forward to examine the likely effectiveness of interventions in the diet. The spatial and societal dimensions of the micronutrient deficiencies revealed in Kevin's work, and of course supported by the literature as well, make us all the more keen to play our part in making such estimates more readily accessible to data use, data owners, and to other users. To us, a really important dimension of the MAPS project is our collaborative working. And this is obviously one great example of it - this way that we've collaborated with USAID Advancing Nutrition, and this particular project being presented by Kevin. In MAPS we've got an ethos of working with potential users of the tool to ensure our work is aligned to user priorities, and that we are transparent and collaborative in the methods we use to process and present data. Thank you for this opportunity to share some information on the MAPS project with

you, and I hope that you find some of the approaches described of interest to you in your work. I would very much like now to turn to Omar, thank you.

Omar Dary

Hello everyone, it is really a good pleasure that more than 200 attendants are in this webinar. And looking all over different continents and very specialized institutions and all of them, it only shows to us that we are combining evidence based to the advocacy. I mean it's easy to do advocacy but it's more difficult really to prove that things are going to work. And that is why Kevin's presentation is very important. He showed to us that the impact or the potential impact of fortification is well beyond the presence of the fortified foods in the markets or even the consumption of those. In the case of Malawi, because the consumption of wheat flour is too small, the impact that is really expected is going to be so little. However also it shows that if we combined two common edible products: oil and sugar with Vitamin A, it was possible to reduce the inadequacy of Vitamin A in the nation by 77 % to 50 %, even using the current fortification scenario. And if everything is improved and the compliance is better accordingly with the actual standards, the reduction of the inadequacy is going to be 37%. But it is important to point out two things here; the impact does not depend in the consumption of the fortified foods, the impact depends in the amount of the nutrients that are delivered to the fortified foods. And that is a function of two things; the content of the nutrients in the fortified food, multiplied by the amount of the intake of those food vehicles. And that is the reason why the urban benefit more than the rural populations, and the not poor benefit more than the very poor. That is the nature of food fortification.

However, despite of that, we move the nutrient intake to the right. That means even those with very low intakes of the Vitamin A in this case now were not inadequate. And the key factor is not providing too much Vitamin A to those already in the high index. But that is shown in Malawi. And some of the questions was why using density and what the apparent intake, and that is related to Gina Kennedy's questions 'what happens if dietary guidelines of reduction of certain foods is in the country. The density is going to tell us what is really the content of the nutrient base and the amount of energy we should have every day. And the adult female equivalent tells us what is happening right now in the country. That is why we

saw in the zinc why despite that the density is low in the whole country in the diet, in the urban areas, apparently the population is not too much affected by the low intakes of zinc. But that is because they are eating a lot or much of these cereals and I know much about probably even the wheat flour. But when that is reduced, that is going to have a problem. That is why it is good to have the combination of the two ways to present. The density to look into the quality of the adult female equivalent to look the apparent intake which is an approximation. The other lesson from this is that the impact is not necessarily at the home level, the fortified foods need to comply with the standards because we need to measure the average content of the nutrient at the home level, and that is the one that we use. Obviously, if we increase the compliance we are going to increase the potential. But the effectiveness of the program is not really dependent on that.

Finally I would like to show that this tool, using the household consumption expenditure survey, is one of the tools that we have and that we can use. Following what Lynette Newfield from GAIN has always said; the tool depends in defeat to the purpose". That means this tool is not to know what is the distribution of the foods among the members of the family, it is not to tell us what the children are eating, even the infant's, No!. It is telling us what is the nature of the diet at the national level by a strata going down to the family, and that allows us to screen the different strata, socio-economic growth, geographical areas, to provide national policy and agriculture, national policies in food fortification, and how we can combine this with other interventions. As the case in Malawi, food fortification is not enough for the very poor, especially in the rural areas. We need to motivate other interventions like biofortification or concentrate and supplementation in those areas. It is also helping us to see what are the designs of the other interventions, what are the nutrient needs to be done, what is the nutrient that we need to put into the supplements in order to improve these things. We also found in this study that in Malawi, apparently, the inadequacy of Vitamin B2 is very high, to our surprise, but folate is not too high. And both are important Vitamin B vitamins. And now we need to look into those and at the country level, how we can use biomarkers really to tell us, and we can confirm that the zinc inadequacy is also in the biomarkers.

In summary, this is a tool that is very important because it provides us timely data at a low cost and fast. And it could be used by nutritionists, epidemiologists, food scientists, agronomists, policymakers. It is helping us to really have something even before the interventions have started. And it is for us to learn a little more how to improve, but also know that we need to combine this with others. Saying so, now it's my pleasure to introduce Alexander.

Alexander Kalimbira

Thank you very much Omar. I'm delighted to have this opportunity to share, with all of you that are attending this webinar today from different parts of the world, the potential uses of the MAPS tool as has been demonstrated by Kevin in terms of policy and programming in my country. I'm a Malawian and I live in this country. As was introduced earlier, I am based at the university and although I teach at the university and do research and outreach programs, I'm privileged because I'm a member of what is called the Malawi Nutrition Policy Advisory Team. This is a small team of between 12 and 15 individuals that the government of Malawi invites periodically to ask them specific questions about policy or programs, and we are supposed to advise the government on what kind of direction they need to take on policy and programming issues that are very critical.

For many years and even up to now Malawi has been focusing largely on reducing stunting, which remains very high. But in recent years, there is a lot of change in terms of the shift, in addition to focusing on growth indicators, there has been a lot of keen interest in micronutrient nutrition. And therefore, the government of Malawi for example would be grappling questions such as (1) Which approaches would accelerate reduction in micronutrient deficiencies; (2) How would different approaches affect the majority of population who live in rural areas of the country where the burden of micronutrient deficiencies tends to be higher than in urban areas. 86 percent of Malawians live in rural areas; only 16% are in urban areas. And you saw the data from Kevin on how those in rural areas are disadvantaged in terms of having access to fortified foods; (3) Government would be interested in a question such as how can the national micronutrient response address seasonal variations in access to critical micronutrients.

Presently, in our country, we pursue several approaches in our effort to curb micronutrient deficiencies and this includes supplementation, as was indicated, of vitamin A, Iron and Folic acid, the fortification of centrally processed foods that Kevin also alluded to cooking your wheat, maize-based products, salt and sugar. Number three biofortification of commonly consumed foods. And right now beans have been bio-fortified with iron and zinc, and also we have a large program on orange flesh sweet potatoes with Beta carotene which is the precursor of Vitamin A. And number four, a few years ago, Malawi also piloted and now introduced in several districts home fortification with 'Mix Me', this is a local version of the Sprinkles that are known globally. And lastly, government pursues dietary modification and diversity to incorporate rich sources of key micronutrients in the diet. And so with so many options that are there on the table, coupled with many things that we don't know of, it would not be easy for a policymaker sitting in the government of Malawi and even programmers to make decisions that would save the nation very well. There is already a question that one of you asked saying 'shall we continue to add Vitamin A to sugar when there is a growing problem of NCDs and overweight and obesity. So, I see Kevin's work, as has been presented, to be an important tool in what I would like to call the Malawi nutrition toolbox, which my colleagues and I would use to save the policy advisory team better, because then we can demonstrate different scenarios and what those scenarios actually would mean to the government of Malawi and to the people of Malawi moving forward. So thank you so very much and now over to Gareth.

Gareth Osman

Thank you very much Alexander and all the presenters, and I would like to thank everyone for participating in the webinar today. It's an honor to be with you all. My role on MAPS in Malawi is to lead the integration and analysis of the newly completed 2020 Household Consumption and Expenditure Survey, the IHS-5 data. And I also support the process of co-designing the MAPS tool here in Malawi. Co-designing is a process in which the future potential users of MAPS tool are invited to assist in ensuring that the questions the tool enables them to answer are a good match for their priorities. Kevin has done an outstanding job with the Malawi IHS-4 data by setting the stage and the pace for some of the most

important and critical analysis and modeling that can be done with the IHS datasets. To date, as Malawi, we have the capacity to conduct similar types of analysis through the use of our training sessions, the sharing of our scripts via GitHub repositories and excellent networking and collaboration within the MAPS team. As a result, we are now proficient in analytical packages predominantly 'r', which enables us to create excellent r-scripts using these types of data sets. And also we are aware of the complexity of these IHS service and the importance of tidying up the data sets. And hence we gain a better understanding of the tidying experience with these tidying processes of these data sets, from data retrieval to the individualization of household consumption using both the per capital approach and other male equivalent approach, as well as the other female equivalent approach that Kevin has just presented.

In addition, we have the local expertise which enables us to easily identify and describe unique food items. Because, at least half of the food items in these data sets have got local names. And finally we are able to make effective use of the food composition tables, which are critical in these analysis, and having our own Malawian food composition table puts us in a stronger position to match and qualify local foods accordingly. The good news is that I began tidying up the HIS-5 data in early May of this year, and we are getting closer to conducting analysis and applying the results in MAPS. Thank you all very much for your attention. And now, back to Jennifer.

Jennifer Yourkavitch

Thank you Gareth and thank you to the panel for those comments. We will now use the rest of our time together; about 26 minutes or so, for questions and discussion. We've been compiling a list of your questions. Please continue to put questions in the Q&A feature of Zoom. To do that you're clicking on the Q&A icon in your Zoom controls, that will pull up the box. You type your question in the space and then click 'send'. We'll try to get to as many questions that we can in the time remaining and we will post written responses to the questions that we cannot get to today. All right so let's go to our first question and Kevin this is for you. What is the difference between the adult male equivalent method and the adult female equivalent method, could you spend some more time explaining that difference?

Kevin Tang

Definitely. With apparent intake, what we are doing with household data is we are individualizing the total foods that are consumed by the household and we are trying to figure out how much of that food is being consumed by each member within the household. The most common way to do that is to individualize per adult male equivalent or however we chose to individualize base of the adult female within the household. And we did that because we were using two different metrics: we are using apparent intake in combination with nutrient density. So with nutrient density, we kept our estimates at the household level. So in order to define inadequacy for that household, we chose a person in the household that had the highest nutrient density requirements with the assumption that if the density was high enough to meet that person's needs, then it would be high enough to meet the needs for everybody in the household. So the person in the household that has the highest nutrient density requirements are the adult females. So, in order to maintain consistency between inadequacy estimates, we chose to individualize for adult female for apparent intake or adult female equivalent in order to maintain consistency between those two.

Jennifer Yourkavitch

That's great okay. Thank you Kevin. And another one for you … will there be any ability to segregate households by livelihood zones also?

Kevin Tang

Yeah! I think that there will be. I think that livelihood zones in Malawi are built from like combining different districts together. So from what I understand, we have done this analysis down to the district level, so if we want to categorize it by livelihoods zone too that's definitely possible. If livelihood zones are not there then we do have like quite precise geographic data that describes the position of these households. So assuming that we have shape files that describe the limits of these livelihood zones and we can definitely run the analysis in that manner as well.

Jennifer Yourkavitch

Okay. Thank you. Then a couple more for you Kevin. The first is for nutrient adequacy: did you use the equivalent of estimated average requirements and did you use adequacy values established by the government of Malawi?

Kevin Tang

Yeah! We used harmonized average requirements which was recommended and published in a paper by Lindsey Allen and colleagues that was published earlier this year. Because our estimates were kept at the level of a population, we used population-based estimates or requirements in order to define whether or not the population was adequate or inadequate, in terms of which estimates or which requirements that we use. Because we individualized by adult females, we use the harmonized adult requirements for the adult female specifically for each of the micronutrients that we evaluated.

Jennifer Yourkavitch

Okay thank you. And this could be for you and perhaps Omar you might have a comment too. Have you considered adding food-based dietary guidelines as a limiting factor in the model? So for example a maximum of 24 grams per day of sugar, so this should not be exceeded for diet quality and there would be similar upper limits for salt and oil.

Kevin Tang

Yeah, that's an interesting question. In short YES, you can definitely do that. I guess […] how we can model a micronutrient intervention and its potential contributions across the population.

Jennifer Yourkavitch

Great and Omar I see you right on. Sorry Kevin I think you're cutting out a bit. Sorry Kevin do you have more to say.

Kevin Tang

No, I'll bounce it to Omar.

Jennifer Yourkavitch

Okay great, thanks. Omar go ahead.

Omar Dary

Thank you Elise and Kevin and for the questions Regina and everyone. Really, one thing at this time, this tool is telling us what is happening not what we want to happen. We can model it. I mean this is something that could be done because we have the index. Actually we can reduce those and then multiply by different food composition tables. But this is giving us the picture of the moment. One thing is what we want, another thing what the communities are doing. And I would like to take advantage here to say that food fortification is an opportunistic type of intervention. It is not promoting the consumption of the fortification vehicles. I mean, at the same time that we can continue using refined wheat flour, rice, oil, sugar, salt, which should be reducing the consumption, if we consume those in a higher amount, we can promote the reduction of them and we can continue using them for modeling fortification. I mean, if we curb down the consumption of oil, we can increase the content of the nutrients into the oil. We need to separate what is the fortification role with the fortifiable foods that is in the different parts, and that is something that we need to keep in mind.

On the other hand, we could not mix a developing country or going into the rural areas with the western societies. We have interventions that are specifically for the countries. And that is why a tool like this one is important, because it will tell us really which are the fortified foods, and which could be the way to fortify them to have impact in the country accordingly with their own context. Thank you.

Jennifer Yourkavitch

Okay, thank you Omar. And we have the next question for Alexander. What is the level of food fortification in Malawi? For example, in Tanzania, fortification is only done by large scale and maybe only a few fortified products can reach the majority of rural areas. So this question is about the scale and level of food fortification in Malawi. And I wonder, Alexander, if you would like to take that or …

Alexander Kalimbira

I will take an aim at that. Nothing is different between Tanzania and Malawi. We are bordering countries. Although there is food fortification in terms of for example wheat products and some maize-based products, they are not largely consumed by the population and very few industries are into that because it's pretty much no market. The major staple food in this country is maize and many of the households in this country, the large majority of us, grow our own maize and keep it in their homes. So even if somebody was fortifying centrally, it would not reach. The only commodities that we know that are reaching out to everyone in the country would be sold. And you're talking about iodine, Vitamin A and sugar. That is the scale presently, thank you.

Jennifer Yourkavitch

Thank you Alexander. The next question is related to that. To what extent is micronutrient fortification of locally produced or native foods, for example maize flour, more beneficial over fortification of imported or foreign foods? So for example wheat flour. This person is not sure if wheat is produced in Malawi, but is asking this question about the fortification of locally produced foods, could that be more beneficial over the fortification of imported or foreign foods.

Alexander Kalimbira

Our wheat production, especially the wheat that is produced in some parts of the country, and they're talking about I think in 2020, was just around 1000 metric tons. And all the wheat that we use in this country for bread and other bakery products is imported wheat. And that's why it becomes attractive to centrally process that because in their small amounts they're able to reach out to some populations. But in remote areas obviously that's a challenge. The problem with fortifying locally produced foods for example maize, as has been given as an example here, not too many people are going to buy the maize product which is in a grocery store because the majority of us, including myself, I grow my own maize and I keep it in the in the home. So I don't need to go to a grocery shop to buy and that's a dilemma. There is however some effort that is taking place for some local produce foods. In my comments I did indicate that there is now fortification with iron and zinc of beans, as an

example. So these are growing issues, we are still looking at what technologies and what are the best ways of delivering micronutrients to the population, thank you.

Jennifer Yourkavitch

Thank you okay. The next question I believe is for Kevin or Omar. What is the advantage of using nutrient density versus apparent intake, and are both equally well understood by non-specialists.

Kevin Tang

Yeah I can take a step at that. First, nutrient density and apparent intake they measure different things. Nutrient density looks at whether or not … like how rich the diet is with a particular micronutrient. So as I said in the presentation, for every bite of food how much does an individual get. And for those who have lower micronutrient densities, they require more bites of food in order to meet their micronutrient needs. This is a more new approach that isn't used as frequently as apparent intake. But we find that using apparent intake, which is the total quantity of micronutrients consumed by the individual, in tandem with one another provides further insight into diets across populations. I think that doing these analyses with both metrics available provides in-depth insight into these diets across populations. I don't know if Omar wants to continue.

Omar Dary

Thank you Kevin. And the question is related to two additional questions that are put at the end. One of them says it is fine to give children foods with 70 % fats and carbohydrates in form of oil and sugar, especially in children under five. Are those because this question I understand is coming from where we are using these foods to deliver these nutrients and using density is part of how we try to solve that problem. Because in the density, it will tell us really which is the quality of the diet. If you remember the data by Kevin, the zinc density in the very poor diet was better than the same density in the not poor populations in the urban centers. That only means that in the urban centers, they are increasing the energy intake by many of these foods and other foods, but the density of the nutrient is reduced. That is an important part but that's the advantage of using the density. But this needs to

combine with some approximation of the intake because it will tell me if the problem is the density or the problem is the intake. The other question, the last one is what happened with the very poor people we promote to consume more? And that is what we are seeing. The very poor rural population in Malawi despite that probably the density of the diet is not too bad, the problem is that they are not eating sufficiently. I mean all of these things are possible to do with the combination of the series of the information that is possible to deduct form this tool. Thank you Kevin and everyone.

Jennifer Yourkavitch

Thank you Omar. And staying with you, we have a question about the discrepancy between dietary inadequacy of Vitamin A with Vitamin A assessed with biomarkers. Could you speak to that?

Omar Dary

Yeah. The data from Kevin was specifically for the assessment of the intake of Vitamin A through the diet. And that has some limitation because we don't know really if we are capturing all the different foods that are providing Vitamin A into the diet, but we have reasonable well that that's the situation. But in the country, there are other programs that are supplying Vitamin A - the Vitamin A every six months supplementation. We have micronutrient powder, we have other things that are happening there. It's important also to know that when we use biomarkers, this is only one point in the time. In the study by Kevin, it was along the year. Which is even a stronger position. The other point is that we don't have a biomarker criteria for women. We are still using the criterion for preschool aged children. And we are interpreting the data observed based on that. And that is why, in most of the countries, we are thinking that there is no Vitamin A deficiency in women, because our criterion is lower than probably biologically needs to be. That is another point. We need to combine inadequacy with biomarkers and try to interpret the information. I think this is only providing us a partial story of what we need to use for our deduction. But that is strong enough for justifying the inclusion of biomarkers in the nutritional surveillance systems.

Jennifer Yourkavitch

Thank you Omar and I think you have touched on a few questions there. Another one that had come in asked about the adult female equivalent method and the assumption there that foods are consumed in proportion to physiological requirements. But that's not always the case. And this participant is wondering how we can better capture individual variations of dietary intake in the absence of 24-hour recall studies. Of particular interest, is to better understand those differences in intake and the potential contribution from large-scale food fortification among girls and women. So you mentioned biomarkers there, do you have any other comments on that or perhaps other panelists want to weigh in on that.

Omar Dary

Let me jump in and then others could complement what I am going to say. The question is from Jonathan Gorstein and this is a myth but probably other things that we need to keep with this type of tools. We should not make this tool so complicated that at the end it becomes so cumbersome to do it or so difficult to start. But at least with this HCES tool, we can identify certain areas of the country that could be used later for a field study. And we can do that. I mean that is something that helps. It reduces the cost of the complementary studies that we need to go to the field and ask, because otherwise it's not possible to find those results. But it helps us to have at least an idea about population strata.

Jennifer Yourkavitch

Thank you Omar. Any other comments on that.

Kevin Tang

I mean I can add something quickly. I guess with intra-household distribution of a household level dietary data, it really depends on the context. From how foods are distributed within the household. We are continuing to do further analyses comparing HCES methods to individual level 24-hour recall methods, to see what the discrepancies are between the two. And there always will remain some. But as we continue to kind of do these studies in different contexts, we hopefully will be able to build up a broader narrative as to whether or not these assumptions hold up, and whether or not we need to develop new metrics or better metrics using the household data, in order to gain better insight into how food is distributed

within the household. The nutrient density metric maintains nutrient density at the household level. So it doesn't make any assumptions with regards to intra-household distribution, but we only do that when we estimate inadequacy. But further research into this area is going to be really important trying to further and build this framework out.

Jennifer Yourkavitch

Thanks Kevin. I was thinking too about looking at correlations with basic women empowerment indicators that are now commonly collected in large surveys. That might provide a clue in some cases.

Kevin Tang

Yeah

Jennifer Yourkavitch

Okay. A couple more for you Kevin. What program did you use to model the fortification scenarios?

Kevin Tang

I used a couple packages in 'r' in order to combine all the data together. All of these programs are openly available and free online and this data is also openly available through the World Bank's LMS web portal. So in theory, anybody could go on and download the data sets and apply these methods as well. I am planning on, when I finish up this analysis, uploading all of the code onto the GitHub repository. So if anyone is interested in kind of seeing any methods in the approach they are able to do that on their own. I kind of joke around where I say that. With this kind of research anybody can go online and do my PhD for me. And I am very happy for anybody to come to help out and contribute out to this area because there's a lot of work to be done here.

Jennifer Yourkavitch

Thanks Kevin, I like the crowd sourcing approach to distributing, all right. Here is the question for the panel. Could fortification be combined with other potential interventions

to look at the assumed combined effect? So we have touched on different aspects of this but I wonder if you have any other comments in this regard.

Kevin Tang

I can take that as well. The answer is YES. So here we just have one example of how a couple of different large-scale food fortification interventions, the potential contributions of those three food vehicles to oil, sugar and wheat flour. However, if we want to run the model where we combine the effects of bio fortification or scale up bio fortification or scale up dietary diversity programs as well, we are able to do that as well. And through the MAPS tool, we are planning on having features as well to be able to combine different interventions together, and explore not only just the potential contributions from these individual interventions as well as combined, but also explore cost effectiveness models to see whether or not what the best strategy is in terms of cost stretchiness, when combining multiple packages together.

Jennifer Yourkavitch

Okay thanks. Here is the question about the proportion of the Malawian population in the lowest, lower middle and middle class rural population, where there is little effect of compliant fortification. Do we know what proportion of the population falls in those categories and do we know where those with micronutrient deficiencies are located in the divisions.

Kevin Tang

Yeah, I guess so. In terms of the rural population, the sample was derived from the last census that was conducted in Malawi where approximately I think it was 82% of the population was found in rural areas. So if we are looking at just the lowest quintile of the rural population that would be approximately 15% of the population; the lowest three would be about 45% of the population would be there. In terms of identifying them within the district like within the geographic zone, that is the big question. How do we reach the folks that need these programs the most? I guess with large scale food fortification that is done, as I mentioned, at the industrial level, with this modeling study we have insights as to who's

not reaching it, who doesn't have access to these programs. However, developing programs and designing programs so that we do reach these populations is going to be critical moving forward.

Jennifer Yourkavitch

Thanks Kevin. And here is a question for the whole panel. This may be the last one we get to today. This participant is looking for your reflections on the extent to which these analyses can be replicated elsewhere, or how HCES data could be strengthened to make stronger inferences. So for example, is there a case to be made for providing guidance on the process of food listing, development and analysis or interpretation, to increase fit-for-purpose? Also, HCES normally asks about food acquisition and not consumption, so is that an area of further exploration. I know some of you have …

Kevin Tang

I can start there. So, as I mentioned, these HCES questionnaire are designed by each country's national specific office, and they generally reflect kind of the data needs for that country. In addition, especially for the food consumption module, the food item lists was designed so they are specific to reflect the diets within those countries. There are some measures that we can do in order to make them more beef or provide better insights for nutritionists. That is to ask in the questionnaire about consumption rather than acquisition, which is a general trend that is happening over the last 20 years, which from our point of view is good. Kind of to go off of that, I guess with HCES data, it's not only nutritionists and epidemiologists that are working with this kind of data. Lots of people use this data in order to kind of gain insights into other areas of living standards, so it is quite a crowded space. So if we try to modify and change any kind of aspect of the questionnaires, we really have to have a good reason for it. But that being said, I hope that, with this example shown here, that this kind of provides more motivation to collect data so that in a way that is best representative of diets across populations. I am not sure if anybody else in the panel wants to chime in as well.

Gareth Osman

Yes, I think I can assist on that because this is what we are doing. So I am accidentally creating a bit of what you have done. So, one of the ways maybe of improving and taking these analysis is the use of sharing of all these works that has been done to avoid the duplication of efforts. Because one thing that I have learned in going through the process of this IHS analyses and the tidying process is the guidance and the direction that have been constantly coming to you. So the access of the scripts via GitHub repositories I think can be very much helpful. Rather than just sitting down on your own and doing this work for yourself, there is a lot that is involved that needs guidance and direction. And also, another thing, I should indicate that creating the guidelines on how these processes have to be going. I guess this is another step that we have to go into so that other countries who are also interested in this type of data sets can take a leave on that. I should also indicate that we are also thinking here as part of strengthening this service that we should not only be receiving or having access to the secondary data, but partnering with government departments such as the National Statistics Offices. I think that can be helping us to be involved in the field activities. So that when we have the secondary data, we should have an idea of what really exactly was happening on the ground. So a bit of contribution to that question. Thank you.

Jennifer Yourkavitch

Thank you so much Gareth. Yep, another?

Louise Ander

Yeah, sorry Jennifer. I was only going to thank Gareth and Kevin for making those points. Certainly, something that's really important to the MAPS project is to try and be very collaborative where we have known or discover other groups that are working on the same data sets, and trying to really make sure we cut down on the replication of this hard work it takes to get data into a format where you're ready to use it. And really helps people to step through that process more efficiently just as described. I think that's very important. And of course, once that's done, the MAPS tool and other projects out there, other tools out there, can all make use of these data and it gets to people much more quickly to a point

where they can start to use these data in their toolbox as Alexander described in their toolbox of information they have. Thank you.

Jennifer Yourkavitch

Thanks Louise and thanks everyone. We have reached our time to close this discussion. We do have a list of questions and we will post written responses. Thank you so much for your questions. They contributed to a really rich discussion. And before we wrap up, I would like to thank again Kevin, Louise, Omar, Alexander and Gareth for sharing their time and expertise today. Thanks to you all for attending. Have a great day.

USAID
FROM THE AMERICAN PEOPLE

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

July 2021

USAID Advancing Nutrition is the Agency's flagship multi-sectoral nutrition project, addressing the root causes of malnutrition to save lives and enhance long-term health and development.

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.