

## Original Article

# Identifying acceptability and price points for purchasing micronutrient powders for children 2 to 5 years old in Nepal

Rajni Gunnala MD, MPH<sup>1</sup>, Cria G Perrine PhD<sup>2</sup>, Giriraj Subedi MPH<sup>3</sup>, Saba Mebrahtu PhD<sup>4</sup>, Pradiumna Dahal MSc, MA<sup>4</sup>, Maria Elena Jefferds PhD<sup>2</sup>

<sup>1</sup>*Epidemic Intelligence Service Program, US Centers for Disease Control and Prevention (CDC), Atlanta, GA USA*

<sup>2</sup>*Division of Nutrition, Physical Activity, and Obesity, CDC, Atlanta, GA, USA*

<sup>3</sup>*Child Health Division, Nepal Ministry of Health and Population, Teku, Kathmandu, Nepal*

<sup>4</sup>*United Nations Children's Fund (UNICEF), Nepal Country Office, UN House, Pulchowk, Nepal*

**Background and Objective:** Little is known about purchasing micronutrient powders (MNP) for children 2-5 years. We describe acceptability for purchasing and price points for MNP for children 2-5 years among caregivers living in districts where free MNP are distributed for children 6-23 months. **Methods and Study Design:** Cross-sectional surveys conducted 3 months after MNP program implementation in 2 districts; 15 months after implementation in 2 different districts. Chi square tests and logistic regression describe associations among socio-demographics and program exposure factors and acceptability of purchasing MNP among 1,261 mothers of children 6-23 months who had heard of MNP. **Results:** Overall, 77.5% and 86.1% of mothers reported acceptability for purchasing MNP in the 3 and 15 month surveys, respectively. Positive pricing attitude (PPA) about paying 150 Nepali rupees for 60 sachets of MNP was reported by 66.3% and 73.4% of mothers. Acceptability for purchasing MNP in both time periods increased with higher wealth quintile and higher maternal education; PPA increased with higher maternal education. Controlling for socio-demographics, program exposure factors associated with acceptability for purchasing MNP included: lack of perceived barriers to MNP intake and health worker counselling (3 month surveys); knowledge of benefits of MNP intake and lack of perceived barriers to MNP intake (15 month surveys). **Conclusions:** Mothers reported acceptability for purchasing MNP and PPA for older children in Nepal. Differences in acceptability were found across socio-demographics and program exposures. Use of these results and further exploration into actual purchasing behaviour can inform future MNP distribution methods in Nepal.

**Key Words:** acceptability to purchase, micronutrient powders, Nepal, price points, iron

## INTRODUCTION

Micronutrient powders (MNP) are powdered preparations of vitamins and minerals that are mixed into semi-solid food that is ready to eat.<sup>1</sup> Approximately 40 countries are implementing home fortification with MNP interventions to combat the high burden of childhood micronutrient deficiencies.<sup>2</sup> The World Health Organization recommends MNP interventions to reduce anemia and improve iron status among children 6 to 23 months of age.<sup>3</sup> With the recent focus on the critical 1,000 day period spanning pregnancy until the child is 2 years of age,<sup>4</sup> most nutrition interventions for children are being planned in this age group. However, older children in many countries still have high burdens of micronutrient deficiencies and could be included in interventions. As many nutritional intervention programs currently rely on limited government and donor resources, expanding a program to include older age groups may require exploring additional funding mechanisms. One potentially sustainable distribution method that has been used for other preventative health

products is a market based approach.<sup>5-7</sup> While a number of studies have described formative research in the area of communities' willingness to purchase MNP, they focus on children 6-23 months old,<sup>8,9</sup> there is little published information on acceptability for purchasing MNP for older children.

In Nepal, the prevalence of anaemia among children 6 to 23 months of age is 69%, and among those 24 to 59 months the prevalence remains high ranging from 25% among children 48 to 59 months to 44% among children 24 to 35 months.<sup>10</sup> Nepal has implemented an integrated

**Corresponding Author:** Dr Maria Elena Jefferds, Division of Nutrition, Physical Activity, and Obesity, CDC, 4770 Buford Highway NE, Mailstop F-77, Atlanta, Georgia 30341, USA. Tel: 1 (770) 488-5227; Fax: 1(770) 488-5369  
Email: MJefferds@cdc.gov

Manuscript received 28 April 2015. Initial review completed 26 July 2015. Revision accepted 27 August 2015.

doi: 10.6133/apjcn.102015.07

infant and young child feeding (IYCF) and MNP intervention in 15 districts that currently provides free MNP for all children 6 to 23 months of age. Given the potential in offering this efficacious intervention to an older, yet still vulnerable age group, this analysis aimed to describe acceptability for purchasing MNP, factors influencing acceptability to purchase, and pricing attitudes towards paying for MNP in Nepal for children aged 2-5 years.

## METHODS

### *Study setting*

Beginning in 2010, the Ministry of Health and Population in Nepal, in collaboration with UNICEF, piloted an integrated IYCF/MNP program designed to provide all children 6-23 months of age with 60 sachets of MNP every 6 months (total of 180 sachets for each child entering the program at 6 months of age). The MNP were locally branded as Baal Vita. Two pilot districts were selected from each of the three ecozones: plains (Rupandehi and Parsa), hill (Makwanpur and Palpa) and mountain (Gorkha and Rasuwa). In Nepal, 83% of the population lives in rural areas<sup>10</sup> and different MNP delivery models were piloted in rural and urban areas of each district. The program had a staggered start across districts and in rural vs. urban areas of each district. The program included identical behaviour change intervention strategies in all districts/models and were distributed through mass communication (radio advertisements, billboards, stickers on female community health volunteer homes), written materials (distribution of brochures and reminder cards) and MNP/IYCF counselling (delivered through monthly mothers group meetings with community volunteers, routine personal encounters with community volunteers, and/or through local health facility staff). Additional details about the pilot program and monitoring surveys are published elsewhere.<sup>11,12</sup>

### *Survey design and sampling*

A cross-sectional household survey was conducted by an external survey organization in several locations during the pilot for program monitoring of this public health intervention. These surveys were representative of all children 6-23 months and were conducted within three months of each other in 2011. Due to the staggered roll out of the program in each district and in rural vs. urban settings, the surveys reflected different time points in two different program settings: 3 months after program implementation in rural and urban areas of Rupandehi and Parsa (plains districts) to assess a newly started program and 15 months after implementation in rural areas only of Makwanpur and Palpa (hill districts) to assess a longer standing program. There were no surveys in the pilot districts located in the mountain ecozone, or in urban areas of Makwanpur and Palpa districts. Using population proportion to size sampling, 30 clusters from each rural district and 30 clusters from urban municipalities across Rupandehi and Parsa were selected (representative of rural areas of each district and representative of urban areas across Rupandehi and Parsa). Within each cluster, a household census was conducted to identify all eligible children; 12 children 6 to 23 months from each cluster

were then randomly selected for a household interview for a sample size of 360 participants per survey. Interviews were conducted with mothers of selected children about program exposure and MNP and IYCF knowledge, experiences, and practices, including MNP intake. There was no replacement for refusals or if there were less than 12 eligible children in a cluster.

### *Outcome variables*

Due to the potential benefits of MNP program intervention for older children and lack of baseline information about acceptability for purchasing MNP in this age group, two questions about older children were included in the household survey. There were two main outcome variables of interest in this analysis asked about children ages 2-5 years. Both questions were asking about a hypothetical purchase as no assessment was made at the time of the survey as to whether a child of 2-5 years was living in the house. The first question examined acceptability for purchasing MNP for children ages 2-5 years. The question asked "Would you be willing to purchase MNP sachets in order to give to your children 2-5 years of age?" The second variable was presence of a positive pricing attitude towards the suggested price of 150 Nepali rupees (USD \$2.09 in 2011) for 60 sachets every 6 months for children ages 2-5 years. The question asked "What do you think of the price of 150 Rupees for 60 sachets if you were to purchase for your child 2-5 years of age every 6 months?" Positive pricing attitude was defined as reporting 'Price is OK' to the suggested price, which was based on UNICEF cost estimates for a 6 month supply of MNP sachets, not including other program costs.

### *Independent variables*

The socio-demographic independent variables included in the analysis were household wealth quintile and maternal education. Predictor variables of program exposure and experiences included knowledge of any benefits of MNP intake (i.e. increased appetite, increased energy or activity, increased immunity, mental development, physical growth, makes child healthy, or makes child stronger), perception of any barriers to MNP intake (included broad categories of: adverse effects on child, difficulty with preparation or serving food with MNP, lack of knowledge about MNP, lack of family support, or lack of available MNP product or accessible distribution facility), perceived access to MNP, any consumption of MNP by the 6-23 month child, receiving information and counselling from health workers or community volunteers about MNP, and hearing radio jingles about MNP. Messages provided during counselling or by radio jingle were considered a proxy for product exposure; they increased awareness, motivation and information about the product. The possible survey response options were not read to participants. Responses for program exposure factors were dichotomized to 'yes' or 'no'; multiple response questions (i.e. knowledge of benefits of MNP intake and perception of any barriers to MNP intake) were required to have at least one positive response to qualify as an overall 'yes'.

An additional independent variable of 'batches of MNP sachets received' was analyzed in a subset of the 15 month survey sample who were eligible to receive multi-

ple batches of 60 MNP sachets (i.e. children  $\geq 12$  months of age). This variable was included as a factor that could influence acceptability since it represented varying durations of program exposure and experiences with MNP.

### **Statistical analysis**

We used Chi square testing for bivariate analyses to describe how socio-demographic and program exposure factors listed above were associated with acceptability for purchasing MNP and pricing attitude. The significance level was set at 0.05.

For analysis, the data from the 3 month surveys were combined ( $n=1,053$ ) and data from the 15 month surveys were combined ( $n=656$ ). We chose to present data from both 3 and 15 month surveys separately since the 3 month setting reflects the perceptions and experiences shortly after intervention launch, while those respondents in the 15 month survey had longer program exposure and experience. Additionally, we were interested in examining the effect of obtaining multiple batches of MNP on acceptability of purchasing MNP, which is only applicable in the 15 month data. Those respondents who had not ever heard of MNP were not asked questions about acceptability for purchasing MNP for older children, so are not included in this analysis. The final sample sizes for these analyses were  $n=731$  for the 3 month surveys in Rupandehi and Parsa and  $n=530$  for the 15 month surveys in Makwanpur and Palpa. As previously described, receiving two or more batches of MNP was examined among a subset of the 15 month survey sample ( $n=328$ ).

We constructed separate logistic regression models to determine associations between predictor variables of program exposure and experiences and acceptability for purchasing MNP in both the 3 and 15 month surveys. The outcome variable was reported acceptability and predictors used were only those program exposure variables found to be significant in the bivariate analyses. For each analysis, all program exposure variables were analyzed in one model because they were part of a comprehensive IYCF/MNP intervention program. We controlled for household wealth quintile and maternal education in the models. The model for 3 month survey data was also adjusted for rural/urban residence.

A de-identified dataset was analyzed using SAS 9.3 (SAS Institute Inc., Cary, NC), accounting for complex survey design. Sample weights were used when combining rural and urban areas of multiple districts for analysis.

Surveys were conducted for program monitoring of a public health intervention and did not require institutional review board approval. The Nepal Ministry of Health and Population approved the data collection. Participation in the interview was voluntary and verbal informed consent was obtained from each woman. Verbal consent was witnessed and formally recorded.

## **RESULTS**

### ***Acceptability for purchasing MNP in plains districts, 3 months after program implementation***

Overall, 3 months after program implementation start, 77.5% of mothers in rural and urban areas of plains districts reported they would be willing to purchase MNP for 2-5 year olds (Table 1). There were no significant differ-

ences in reported acceptability for purchasing MNP by rural/urban residence, but acceptability was positively associated with higher wealth quintile and higher maternal education. Perceiving no barriers to child MNP intake was positively associated with acceptability for purchasing MNP, as was exposure to information and counselling on MNP from a health worker or community volunteer (Table 1). When controlling for socio-demographic factors and other program exposures and experiences, mothers with no perceived barriers to child MNP intake had six times the odds of reporting acceptability for purchasing MNP compared to those with any perceived barriers (Table 2). Examples of commonly reported perceived barriers included: loose or dark stools after MNP intake, child rejecting food with MNP, child vomiting after MNP intake and lack of knowledge about MNP. Those with exposure to information and counselling from a health worker had two times the odds of reporting acceptability for purchasing MNP compared to those without exposure. Mothers exposed to information and counselling from a community volunteer did not have increased odds of acceptability for purchasing MNP compared to those without exposure, when controlling for socio-demographics.

### ***Acceptability for purchasing MNP in hills districts, 15 months after program implementation***

Overall, in rural areas of hills districts 15 months after intervention start, 86.1% of mothers reported acceptability for purchasing MNP for 2-5 year olds (Table 1). Acceptability was significantly and positively associated with higher wealth quintile and higher maternal education. Acceptability for purchasing MNP was also associated with knowledge of any benefits of MNP intake, not perceiving barriers to MNP intake, perceiving that MNP were accessible, consumption of MNP, and hearing the radio jingle about MNP (Table 1). Among participants with children eligible to receive more than one batch of MNP ( $\geq 12$  months of age), those who received two or more batches of 60 sachets of MNP vs. only one batch had a significantly higher prevalence of reported acceptability (94.3% vs 80.7%, respectively;  $p < 0.01$  (data not shown)).

When controlling for socio-demographic factors and other program exposures and experiences, those with knowledge of any benefits of MNP intake had almost three times the odds of reporting acceptability for purchasing MNP compared to mothers with no knowledge of any benefits (Table 3). In the same model, mothers with no perceived barriers to MNP intake also had three times the odds of reporting acceptability compared to mothers who perceived any barriers. Perceived access to MNP or maternal report of any child consumption of MNP did not have significant associations with reported acceptability for purchasing MNP when controlling for socio-demographics and other program exposures.

### ***Pricing attitudes in plains districts, 3 months after program implementation***

Overall, 66.3% of mothers in plains districts 3 months after program implementation started reported that the suggested price of 150 Nepali Rupees for a 6 month supply of MNP was ok, with few reporting the price was too

**Table 1.** Reported acceptability for purchasing MNP for 2-5 year olds by socio-demographics & program exposure factors

	Plains districts, 3 months after program implementation <sup>†</sup>			Hills districts, 15 months after program implementation <sup>‡</sup>		
	Reported acceptability		<i>p</i> value	Reported acceptability		<i>p</i> value
	<i>n</i> <sup>§</sup>	%		<i>n</i> <sup>§</sup>	%	
Total	729	77.5		530	86.1	
Socio-demographic factors						
Household wealth quintile (Q)			0.01			0.02
Q1 - lowest	84	64.7		141	82.3	
Q2	117	76.0		156	81.8	
Q3	159	74.7		117	87.4	
Q4	168	76.9		85	95.1	
Q5 - highest	201	87.8		31	96.5	
Maternal education			<0.01			<0.01
None	292	72.5		101	71.1	
Primary/adult/informal <sup>¶</sup>	167	73.5		207	83.1	
Secondary/higher secondary	270	85.9		222	96.3	
Geography			0.22			N/A
Urban	192	83.8		N/A	N/A	
Rural	537	76.3				
Program exposure factors						
Knowledge of any benefits of MNP intake <sup>††</sup>			0.39			<0.01
Yes	620	78.3		448	89.6	
No	104	73.8		81	67.1	
Perceived any barriers to MNP intake <sup>††</sup>			<0.01			<0.01
Yes	331	66.3		263	81.5	
No	250	92.4		190	94.1	
Perceived MNP were accessible			0.55			<0.01
Yes	595	77.0		463	88.0	
No	75	73.3		43	71.6	
Child 6-23 mo consumed any MNP			0.86			0.02
Yes	551	77.7		422	87.8	
No	178	76.9		108	80.0	
Exposure to information and counselling about MNP from health worker			0.02			0.74
Yes	313	83.3		238	85.4	
No	414	73.5		288	86.6	
Exposure to information and counselling about MNP from community volunteer			0.02			0.41
Yes	143	85.2		92	89.0	
No	578	75.6		435	85.9	
Heard radio jingle about MNP			0.10			0.01
Yes	93	84.3		219	90.5	
No	636	76.5		311	83.0	

MNP: micronutrient powders.

<sup>†</sup>3 months after implementation start in rural and urban settings of Rupandehi and Parsa districts located in the plains ecozone of Nepal.

<sup>‡</sup>15 months after implementation start in rural settings of Makwanpur and Palpa districts located in the hills ecozone of Nepal.

<sup>§</sup>*N* is total denominator and may differ between rows due to missing values or Don't Know responses.

<sup>¶</sup>Includes those who received no formal education.

<sup>||</sup>Rural districts weighted.

<sup>††</sup>Must have at least 1 positive response to multiple response question.

low (Table 4). Positive pricing attitude increased significantly with higher wealth quintile, higher maternal education and urban residence.

#### ***Pricing attitudes in hills districts, 15 months after program implementation***

In hills districts 15 months after intervention start, 73.4% of mothers overall reported the suggested price was acceptable (Table 4). No significant difference was seen in pricing attitude by wealth quintile, but positive pricing attitude increased significantly with higher maternal education.

#### **DISCUSSION**

Overall, Nepali mothers in rural and urban areas of plains districts who were surveyed 3 months after an MNP intervention program rollout, as well as those living in other rural areas in hills districts 15 months after intervention rollout, reported acceptability for purchasing MNP and positive pricing attitudes for MNP for children 2-5 years old. Among mothers surveyed after 3 months, there was a higher proportion of reported acceptability among those in higher wealth quintiles and with higher levels of education. Positive pricing attitude in the 3 month surveys in the plains districts also correlated with higher wealth quintile and maternal education, in addition to urban residence. In the 15 month surveys conducted in the hills

**Table 2.** Adjusted odds ratios of acceptability for purchasing MNP, by MNP program exposure, in plains districts, 3 months after program implementation<sup>†</sup>

Program exposure	aOR <sup>‡</sup> (95% CI)
Perceived any barriers to MNP intake	
Yes	1.00
No	6.38 (3.21, 12.7)
Exposure to information and counselling about MNP from health worker	
Yes	2.03 (1.16, 3.53)
No	1.00
Exposure to information and counselling about MNP from community volunteer	
Yes	1.58 (0.82, 3.03)
No	1.00

MNP: micronutrient powders.

<sup>†</sup>3 months after implementation start in rural and urban settings of Rupandehi and Parsa districts located in the plains ecozone of Nepal.

<sup>‡</sup>Model includes all program exposures listed in the table, which are those found to be significantly associated with the outcome in bivariate analyses, and adjusted for household wealth quintile, maternal education, and urban/rural residence.

**Table 3.** Adjusted odds ratios of reported acceptability for purchasing MNP, by MNP program exposure, in Hills districts, 15 months after program implementation<sup>†</sup>

Program exposure	aOR <sup>‡</sup> (95% CI)
Knowledge of any benefits of MNP intake	
Yes	2.96 (1.18, 7.39)
No	1.00
Perceived any barriers to MNP intake	
Yes	1.00
No	3.20 (1.13, 9.11)
Perceived MNP were accessible	
Yes	1.71 (0.45, 6.48)
No	1.00
Child 6-23 mo consumed any MNP	
Yes	0.83 (0.20, 3.50)
No	1.00
Heard radio jingle about MNP	
Yes	1.99 (0.96, 4.12)
No	1.00

MNP: micronutrient powders.

<sup>†</sup>15 months after implementation start in rural settings of Makwanpur and Palpa districts located in the hills ecozone of Nepal.

<sup>‡</sup>Model includes all program exposures listed in the table, which are those found to be significantly associated with the outcome in bivariate analyses, and adjusted for wealth quintile and maternal education.

districts, a higher proportion of mothers who reported acceptability for purchasing MNP were in higher wealth quintiles and had higher levels of education. Positive pricing attitude in the 15 month surveys correlated with higher maternal education.

Differences in reported acceptability for purchasing MNP and pricing attitudes across socio-demographic factors highlight the need to assess a population's willingness and ability to pay when planning market-based MNP intervention programs. When acceptability for purchasing MNP varies across wealth quintiles, one possible market-based strategy could be a mixed

approach where MNP is sold to those in higher wealth quintiles, while it is subsidized or provided for free to those in lower wealth quintiles.<sup>13</sup> In our analyses the suggested price of 150 Nepali Rupees reflected only the procurement cost of 60 MNP sachets every 6 months and did not include other program costs (e.g. transportation, training and supervision, or behavior change intervention strategies), which could be important to include when setting the price to assess positive pricing attitudes if these costs are not expected to be subsidized. For example, it might be necessary to consider additional costs for differential branding of MNP products that are sold vs. given for free, while alternatively the private sector might absorb the costs of MNP supply chain distribution and relieve this cost from the public sector. Results from selling other public health interventions, such as water purification technologies and contraception, have found even small increases in price can discourage people from buying a product, highlighting the importance of affordability and identifying the price for the product.<sup>5,6,14</sup>

We identified positive associations between reported acceptability for purchasing MNP for older children and several modifiable program exposure and experience variables reported by caregivers. Program staff could potentially improve caregiver experiences, knowledge, skills, motivation, and exposure to the IYCF/MNP intervention package components through increased reach, intensity, fidelity, or quality of the behaviour change strategies, which might result in increased acceptability for purchasing MNP in a population. For example, in the 3 month surveys conducted in plains districts, lack of perceived barriers to MNP intake and exposure to information and counselling about MNP from a health worker were associated with acceptability. Knowledge of benefits of MNP intake and lack of perceived barriers to MNP intake were associated with acceptability for purchasing MNP in the 15 month survey districts. Notably, the association between lack of perceived barriers and reported acceptability for purchasing MNP appeared to be strongest amongst all predictors assessed in both 3 and 15 month surveys. Given that perception of barriers to using MNP would likely be resolved through counselling and other troubleshooting strategies (i.e. improved instruction on how to mix and prepare food for use with MNP in order to increase palatability for child), it is not surprising that a review of existing MNP intervention programs<sup>15</sup> suggests that a strong behaviour change component is necessary in order to be successful. Those designing interventions that require participants to pay for MNP should consider how to ensure high quality behaviour change intervention designs and good fidelity in their implementation.

Market-based strategies for selling MNP for young children are an example of sales-based models for MNP distribution and have been carried out in a variety of settings and can include distribution through public and private sector delivery channels.<sup>16</sup> The BRAC program in Bangladesh uses community-based entrepreneurs to sell baskets of goods that include MNP in remote rural villages. Though the study period has ended, the Nyando Integrated Child Health & Education (NICHE) Project in western Kenya examined community based sales of MNP

**Table 4.** Prevalence of attitude to price of 150 Nepali Rupees (approx. USD 2.09<sup>†</sup>) for 60 sachets of MNP every 6 months for 2-5 year olds, by socio-demographics

	Price			n <sup>§</sup>	p value
	Ok (%)	Too high (%)	To low (%)		
Plains districts, 3 months after program implementation <sup>‡</sup>					
Total	66.3	29.2	4.6	731	
Wealth quintile (Q)					<0.01
Q1 - lowest	44.7	53.5	1.8	82	
Q2	56.7	36.1	7.3	117	
Q3	65.1	33.0	1.9	160	
Q4	67.2	27.6	5.3	170	
Q5 - highest	82.8	11.4	5.8	202	
Mother's education					<0.01
None	55.7	40.9	3.4	293	
Primary/adult/informal <sup>¶</sup>	62.1	32.3	5.5	168	
Secondary/higher secondary	81.0	13.7	5.2	270	
Geography					<0.01
Urban	80.3	15.5	4.2	191	
Rural <sup>  </sup>	63.6	31.8	4.6	540	
Hills districts, 15 months after program implementation <sup>††</sup>					
Total	73.4	20.0	6.5	530	
Wealth quintile (Q)					0.09
Q1 - lowest	67.8	27.6	4.6	139	
Q2	69.5	20.1	10.4	155	
Q3	78.2	18.0	3.8	115	
Q4	80.9	12.7	6.4	85	
Q5 - highest	80.4	12.9	6.7	30	
Mother's education					<0.01
None	58.6	33.1	8.3	99	
Primary/adult/informal <sup>¶</sup>	71.5	20.5	8.0	205	
Secondary/higher secondary	82.4	13.3	4.3	220	

MNP: micronutrient powders.

<sup>†</sup>Based on currency conversion dated October 2011.<sup>‡</sup>3 months after implementation start in rural and urban settings of Rupandehi and Parsa districts located in the plains ecozone of Nepal.<sup>§</sup>N is total denominator; may differ from Table 1 due to missing values (includes Don't Know responses).<sup>¶</sup>Includes those who received no formal education.<sup>||</sup>Rural districts weighted.<sup>††</sup>15 months after implementation start in rural settings of Makwanpur and Palpa districts located in the hills ecozone of Nepa.

for children 6-59 months through the Safe Water and AIDS Project<sup>17-19</sup> and found that sustained program promotion was required for intervention sustain ability. In Bolivia, 60 MNP sachets are distributed for free once a year to children 6 to 23 months of age, but the policy environment also allows for sale of MNP through private sector pharmacies.<sup>20</sup> Understanding the regulatory environment is a key step in assessing the viability of a market-based approach, as well as effective delivery and sales channels. More information is needed about mixed market-based and free distribution projects, factors that enable and inhibit purchasing behaviour, and the potential for market-based strategies for MNP in 2-5 year olds who often have a high burden of micronutrient deficiencies but do not fall within the prioritized 1,000 days focus of many MNP interventions.

Strengths of this analysis include the use of programmatic population based surveys. We were also able to describe results from two distinct program time periods (immediately after program launch, as well as 15 months after program rollout), and in both urban and rural areas. Lastly, this analysis allowed us to examine both modifiable (program exposure) and non-modifiable (socio-demographic) factors in a realistic field setting in order to inform national nutrition policy.

There are limitations to this analysis. No data were collected about whether there was a child 2-5 years old in the household at the time of the survey, thus potentially creating the need for a theoretical response to the acceptability to purchase and pricing attitude survey questions. Participants who had not heard of MNP were not asked about purchasing MNP; future surveys could address this loss of potentially useful data by asking caregivers who had not heard of MNP about acceptability to purchase MNP. Additionally, sample sizes for several of the exposures (perceived barriers and perceived accessibility of MNP) were reduced by 5% or more due to 'Don't Know' and 'Missing' responses. This could potentially be addressed in future surveys by assessing the reasons for such responses. Finally, just as reported willingness to pay often overestimates actual willingness to pay,<sup>6,21</sup> reported acceptability for purchasing MNP in our analysis may overestimate actual purchasing behaviour. This may be due to a bias towards socially acceptable reporting, or the fact that those interviewed may not have been the only decision makers in charge of household finances. In Nepal, women often have limited autonomy to make independent health care or economic decisions for her family or self, especially when it requires the use of economic resources.<sup>22-24</sup> Examining acceptability to purchase MNP and price points among fathers in Nepal would be useful.

The results from this analysis provide a positive framework from which to further explore actual purchasing behaviour in Nepal using experimental methods, such as market simulations, which could then be used to better delineate existing demand for MNP. A market-based approach for distribution of MNP could potentially offer an efficacious intervention to an older age group with a large burden of micronutrient deficiencies and ease some of the burden placed on the public sector, potentially improving program sustainability.

### Conclusion

This analysis identified acceptance for purchasing MNP for older children 2 to 5 years in Nepal and a positive pricing attitude for paying 150 Nepali rupees for 60 MNP sachets at two time points: shortly after intervention start (3 months) when project investment is usually high, and 15 months after program start where activities are more routine and may better reflect regular ongoing performance. Reported acceptability for purchasing MNP differed by socio-demographics and program exposures and experiences. Findings from this initial assessment can provide the impetus for further exploration into actual purchasing behavior for MNP in older children, which can ultimately inform future MNP distribution options in Nepal.

### AUTHOR DISCLOSURES

None declared. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC, UNICEF or any other organizations involved.

### FUNDING SOURCE

The Government of Nepal, Ministry of Health and Population and UNICEF Nepal Country Office supported the implementation of the pilot intervention. UNICEF Nepal funded an agency to conduct the external surveys.

### REFERENCES

- Zlotkin SH, Schauer C, Christofides A, Sharieff W, Tondeur MC, Hyder SM. Micronutrient sprinkles to control childhood anaemia. *PLoS Med.* 2005;2:e1. doi: 10.1371/journal.pmed.0020001.
- Jefferds ME, Irizarry L, Timmer A, Tripp K. UNICEF-CDC global assessment of home fortification interventions 2011: Current status, new directions, and implications for policy and programmatic guidance. *Food Nutr Bull.* 2013;34:434-43.
- World Health Organization. Guideline: Use of multiple micronutrient powders for home fortification of foods consumed by infants and children 6-23 months of age. Geneva: WHO; 2011.
- United Nations Children's Fund. Improving child nutrition: the achievable imperative for global progress. New York: UNICEF; 2013.
- PSI Impact Report: Healthy lives measurable results. Washington DC, Population Services International, 2012 [cited 2014/5/1]; Available from: [http://issuu.com/healthylives/docs/final\\_psi\\_impact\\_report](http://issuu.com/healthylives/docs/final_psi_impact_report).
- Null C, Kremer M, Miguel E, Hombrados JG, Meeks R, Zwane AR. Willingness to pay for cleaner water in less developed countries: systematic review of experimental evidence. London: International initiative for impact evaluation, 2012. [cited 2014/4/14]; Available from <http://www.3ieimpact.org/media/filer/2012/05/28/sr006.pdf>.
- Prata N, Vahidnia F, Potts M, Dries-Daffner I. Revisiting community-based distribution programs: are they still needed? *Contraception.* 2005;72:402-7.
- Alive & Thrive. Micronutrient powder in Viet Nam: Summary report. Ha Noi, Viet Nam: Alive & Thrive; 2012.
- Tripp K, Perrine CG, de Campos P, Knieriemen M, Hartz R, Ali F, Jefferds ME, Kupka R. Formative research for the development of a market-based home fortification programme for young children in Niger. *Matern Child Nutr.* 2011;7(Suppl 3):82-95. doi: 10.1111/j.1740-8709.2011.00352.x.
- Ministry of Health and Population (MOHP) [Nepal], New ERA, ICF International Inc. Nepal Demographic and Health Survey 2011. Kathmandu, Nepal: Ministry of Health and Population, New ERA, and ICF International, Calverton, Maryland; 2012.
- Jefferds MED, Mirkovic, KR, Subedi GR, Mebrahtu S, Dahal P, Perrine CG. Predictors of micronutrient powder sachet coverage in Nepal. *Matern Child Nutr.* 2015;11(Suppl 4):77-89. doi: 10.1111/mcn.12214.
- Mirkovic KR, Perrine CG, Subedi G, Mebrahtu S, Dahal P, Jefferds MED. Micronutrient powder use and infant and young child feeding practices in an integrated pilot program. *Asia Pac J Clin Nutr.* 2016;25:350-5. doi: 10.6133/apjcn.2016.25.2.19.
- Results for Development Institute. Nutrition for a better tomorrow: scaling up delivery of micronutrient powders for infants and young children. Washington DC: R4D; 2013.
- Evans WD, Tarubekera N, Longfield K, Snider J. Brand equity and willingness to pay for condoms in Zimbabwe. *Reprod Health.* 2011;8:29. doi: 10.1186/1742-4755-8-29.
- De Pee S, Irizarry L, Kraemer K, Jefferds MED. Micronutrient powder interventions: the basis for current programming guidance and needs for additional knowledge and experience. Switzerland: Sight and Life; 2013. pp. 51-6.
- Siekman J, Timmer A, Irizarry L. Home fortification using market-based approaches: the potential of market-based approaches to complement free public distribution of micronutrient powders (MNP). Switzerland: Sight and Life; 2013. pp. 34-8.
- Jefferds ME, Ogange L, Owuor M., Cruz K, Person B, Obure A, Suchdev PS, Ruth LJ. Formative research exploring acceptability, utilization, and promotion in order to develop a micronutrient powder (Sprinkles) intervention among Luo families in Western Kenya. *Food Nutr Bull.* 2010; 31:S179-85.
- Suchdev PS, Ruth LJ, Woodruff BA, Mbakaya C, Mandava U, Flores-Ayala R, Jefferds ME, Quick R. Selling sprinkles micronutrient powder reduces anemia, iron deficiency, and vitamin A deficiency in young children in western Kenya: a cluster-randomized controlled trial. *Am J Clin Nutr.* 2012; 95:1223-30.
- Suchdev PS, Shah A, Jefferds ME, Eleveld A, Patel M, Stein AD, Macdonald B, Ruth L. Sustainability of market-based community distribution of Sprinkles in western Kenya. *Matern Child Nutr.* 2013;9:78-88.
- Maclean A, Chowdhury J, Loayza M, Neufeld LM. Chispitas in Bolivia: Experience and case study. Switzerland: Sight and Life; 2013. pp. 31-3.
- Segrè J, Winnard K, Teweldebrhan HA, Abebe Y, Shilane D, Lapping K. Willingness to pay for lipid-based nutrient supplements for young children in four urban sites of Ethiopia. *Matern Child Nutr.* 2015;11(Suppl 4):16-30. doi: 10.1111/mcn.12022.
- Thapa DK, Niehof A. Women's autonomy and husbands' involvement in maternal healthcare in Nepal. *Soc Sci Med.* 2013;93:1-10. doi: 10.1016/j.socscimed.2013.06.003.
- Onta S, Choulagai B, Shrestha B, Subedi N, Bhandari GP, Krettek A. Perceptions of users and providers on barriers to utilizing skilled birth care in mid- and far-western Nepal: a

- qualitative study. *Glob Health Action*. 2014;7:24580. doi: 10.3402/gha.v7.24580.
24. Atteraya MS, Kimm H, Song IH. Women's autonomy in negotiating safer sex to prevent HIV: Findings from the 2011 Nepal Demographic and Health Survey. *AIDS Educ Prev*. 2014;26:1-12.