Supplemental Table 1. Nutrient content per 1g sachet of micronutrient powder. Hexagon Nutrition (Tamil Nadu, India) and DSM Nutritional Products (Basil, Switzerland). Micronutrient Powder and IYCF Intervention, Amuria and Soroti districts, Uganda 2015-16

|  |  |  |
| --- | --- | --- |
| Micronutrient | Amount per 1g sachet  Hexagon Formulation | Amount per 1g sachet  DSM Formulation |
| Vitamin A (retinol equivalent) | 400.0 µg | 519 µg |
| Vitamin D3 | 5.0 µg | 6.5 µg |
| Vitamin E  (tocopherol equivalent) | 5.0 mg | 5.5 mg |
| Thiamine (B1) | 0.5 mg | 0.6 mg |
| Riboflavin (B2) | 0.5 mg | 0.6 mg |
| Pyridoxine (B6) | 0.5 mg | 0.6 mg |
| Cyanocobalamin (B12) | 0.9 µg | 1.1 µg |
| Niacin (B3) | 6.0 mg | 6.6 mg |
| Folic acid (B9) | 90.0 µg 1 | 188 µg |
| Vitamin C | 30.0 mg | 36.0 mg |
| Iron | 10.0 mg 2 | 11.0 mg 3 |
| Zinc | 4.1 mg | 4.5 mg |
| Copper | 0.56 mg | 0.62 mg |
| Selenium | 17.0 µg | 19.0 µg |
| Iodine | 90.0 µg | 108.0 µg |

1 Equivalent to 150 µg Dietary Folate Equivalent (DFE).

2 As ferrous fumarate.

3 As elemental iron (25%) and NaFe(III)EDTA

Supplemental Table 2. Difference-in-difference in mean unadjusted ferritin, and unadjusted RBP concentrations among children 12-23 months between intervention (Amuria) and non-intervention (Soroti) districts, Micronutrient Powder and IYCF Intervention Baseline Survey 2015 and Endline Survey 2016, Amuria and Soroti districts, Uganda 2015-16 1

|  |  |  |
| --- | --- | --- |
|  | β (95% CI) | *P* |
| Serum ferritin 3, µg/L |  |  |
| Base Model | 0.92 (-0.26, 11.10) | 0.8 |
| Adjusted Model | 6.85 (-1.30, 15.00) | 0.1 |
| Serum RBP 4, µmol/L |  |  |
| Base Model | -0.00006 (-0.05, 0.05) | 0.9 |
| Adjusted Model | -0.01 (-0.06, 0.04) | 0.7 |

1Unweighted sample sizes are 2782 (hemoglobin) and 2749 (ferritin and RBP). Base model estimates are the beta coefficients and 95% confidence intervals for the interaction term specifying exposure to the MNP intervention controlling for: fixed effects of district (Amuria vs. Soroti), year (2016 vs. 2015), child sex, and child age group (12-17mo vs. 18-2mo). Adjusted models additionally control for household wealth tertile, caregiver schooling level (no formal or some primary education vs. other education level), improved water source, malaria (assessed by rapid test kit), and caregiver report of fever in the two weeks preceding the survey, and caregiver report of diarrhea in the two weeks preceding the survey. Confidence intervals account for weighting and complex sampling design.

Abbreviations: Abbreviations: AGP, ɑ-1 acid glycoprotein; CRP, C- reactive protein; MNP, micronutrient powder; RBP, Retinol-binding protein.

Supplemental Table 3. Adjusted difference-in-difference in the prevalence (APDiD) of unadjusted iron deficiency, unadjusted iron deficiency anemia, and unadjusted vitamin A deficiency among children 12-23 months between intervention (Amuria) and non-intervention (Soroti) districts, Micronutrient Powder and IYCF Intervention Baseline Survey 2015 and Endline Survey 2016, Amuria and Soroti districts, Uganda 2015-16 1

|  |  |  |
| --- | --- | --- |
|  | APDiD (95% CI) | *P* |
| Iron deficiency 2 |  |  |
| Base Model | -3.3 (-8.7, 2.2) | 0.2 |
| Adjusted Model | -4.7 (-9.7, 0.3) | 0.06 |
| Iron deficiency anemia 3 |  |  |
| Base Model | -2.3 (-6.2, 1.6) | 0.2 |
| Adjusted Model | -2.9 (-6.7, 0.8) | 0.1 |
| Vitamin A deficiency 4 |  |  |
| Base Model | -4.1 (-10.7, 2.4) | 0.2 |
| Adjusted Model | -2.7 (-9.2, 3.8) | 0.4 |

1Unweighted sample sizes are 2782 (anemia) and 2749 (iron deficiency, iron deficiency anemia, and vitamin A deficiency). Base model estimates are the difference in the prevalence (95% CI) for exposure to the MNP intervention controlling for: fixed effects of district (Amuria vs. Soroti), year (2016 vs. 2015), sex, and age group (12-17 months vs. 18-23 months). The adjusted model additionally controls for household wealth tertile, caregiver schooling level (no formal or some primary education vs. other education level), improved water source, malaria (assessed by rapid test kit), and caregiver report of fever and/or diarrhea in the two weeks preceding the survey. Confidence intervals account for weighting and complex sampling design.

2 Iron deficiency was defined as unadjusted ferritin <12.0 μg/L (13).

3 Iron deficiency anemia was classified as altitude-adjusted Hb <11.0 g/dL and unadjusted ferritin <12.0 μg/L (13).

4 Vitamin A deficiency was defined as unadjusted RBP <0.79 µmol/L in the baseline sample and RBP <0.67 µmol/L in the endline sample. To find the population-specific RBP cut-point for each survey, we regressed RBP on retinol to determine the RBP equivalent of retinol <0.70 µmol/L based on the subsample of 39 children for whom serum retinol was assessed using HPLC from a second blood draw (14).

Abbreviations: AGP, ɑ-1 acid glycoprotein; APDiD, adjusted prevalence difference-in-difference; CRP, C- reactive protein; MNP, micronutrient powder; RBP, retinol binding protein.

Supplemental Table 4.Micronutrient status by MNP sachet coverage and recent MNP intake at endline, Micronutrient Powder and IYCF Intervention, Amuria (intervention) district, Uganda 2016 (*n*=747)1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Low MNP Sachet Coverage  (<60 sachets every 6 mo) 2  (n=347) | | High MNP Sachet Coverage  (≥60 sachets every 6 mo) 2  (n=400) | |  | No Recent MNP Intake (No MNP intake last 14 days) 3  (n=234) | | Recent MNP Intake  (Any MNP intake last 14 days) 3  (n=444) | |  |
| Sociodemographic or health characteristic | *n* | % (95% CI) | *n* | % (95% CI) | *P* | *n* | % (95% CI) | *n* | % (95% CI) | *P* |
| Hemoglobin 4, g/dL | 347 | 10.8 (10.6,11.0) | 400 | 10.6 (10.5,10.8) | 0.08 | 234 | 10.9 (10.6,11.1) | 444 | 10.7 (10.5,10.8) | 0.2 |
| Serum ferritin 5, µg/L | 347 | 21.9 (20.1,23.9) | 400 | 17.7 (16.4,19.2) | 0.0008 | 234 | 18.5 (16.8,20.4) | 444 | 20.3(19.1,21.6) | 0.08 |
| Serum RBP 5, µmol/L | 347 | 1.29 (1.25,1.33) | 400 | 1.31 (1.27,1.35) | 0.5 | 234 | 1.29 (1.24,1.35) | 444 | 1.32 (1.29,1.36) | 0.2 |
| Anemia 6, % | 171 | 49.3 (43.6,55.0) | 207 | 51.8 (46.5,57.0) | 0.4 | 108 | 46.2 (39.0,53.3) | 231 | 52.0 (47.5,56.5) | 0.09 |
| Iron deficiency 7, % | 65 | 18.7 (13.5,23.9) | 94 | 23.5 (18.9,28.1) | 0.1 | 55 | 23.5 (17.3,29.8) | 84 | 18.9 (15.0,22.9) | 0.09 |
| Iron-deficiency anemia 8, % | 26 | 7.5 (4.4,10.6) | 39 | 9.8 (6.8,12.7) | 0.3 | 21 | 9.0 (4.9,13.0) | 33 | 7.4 (5.1,9.8) | 0.3 |
| Vitamin A deficiency 9, % | 3 | 0.9 (0.0,1.9) | 1 | 0.3 (0.0,0.8) | 0.2 | 3 | 1.3 (0.0,2.7) | 1 | 0.2 (0.0,0.7) | 0.08 |

1 Ns are unweighted. Values presented are geometric mean (95% CI) or percent (95% CI). P values calculated for linear contrast tests (continuous variables) and Rao-Scott chi-square tests (categorical variables). Confidence intervals account for weighting and complex sampling design.

2 High MNP sachet coverage was defined as having reported receiving at least 60 sachets (2 boxes) every six months during the 12 month pilot - the minimum recommended dose per the 2011 WHO guideline (18), while low MNP sachet coverage was reported MNP sachet receipt below this threshold.

3 Recent MNP intake defined as reporting any consumption of MNP during the two weeks preceding the survey, among those who reported ever receiving MNP.

4 Hemoglobin adjusted for altitude.

5 Biomarker was regression-adjusted to a pooled country reference to correct for inflammation using CRP and AGP (12).

6 Anemia defined as altitude-adjusted hemoglobin < 11.0 g/dL (13).

7 Iron deficiency defined as inflammation-adjusted serum ferritin <12 μg/L (13).

8 Iron deficiency anemia defined as altitude-adjusted hemoglobin <11.0 g/dL and inflammation-adjusted serum ferritin <12.0 μg/L (13).

9 Vitamin A deficiency was defined as adjusted RBP <0.67 µmol/L in the endline sample. To find the population-specific RBP cut-point, we regressed RBP on retinol to determine the RBP equivalent of retinol <0.70 µmol/L based on the subsample of 39 children for whom serum retinol was assessed using HPLC from a second blood draw (14).

Abbreviations: AGP, ɑ-1 acid glycoprotein; CRP, C- reactive protein; MNP, micronutrient powder; RBP, retinol-binding protein.

Supplemental Table 5.Micronutrient status by MNP sachet coverage at endline per updated 2016 WHO recommended dose, Micronutrient Powder and IYCF Intervention, Amuria (intervention) district, Uganda 2016 (*n*=747)1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Low MNP sachet coverage per updated 2016 WHO recommendation  (<90 sachets every 6 mo) 2  (n=593) | | High MNP sachet coverage per updated 2016 WHO recommendation  (≥90 sachets every 6 mo) 2  (n=154) | |  |
| Sociodemographic or health characteristic | *n* | % (95% CI) | *n* | % (95% CI) | *P* |
| Hemoglobin 3, g/dL | 593 | 10.8 (10.6,10.9) | 154 | 10.5 (10.3,10.8) | 0.1 |
| Serum ferritin 4, µg/L | 593 | 19.8 (18.5,21.1) | 154 | 18.9 (17.1,20.6) | 0.3 |
| Serum RBP 4, µmol/L | 593 | 1.30 (1.26,1.34) | 154 | 1.31 (1.25,1.36) | 0.9 |
| Anemia 5, % | 295 | 49.7 (45.3,54.2) | 83 | 53.9 (45.3,62.5) | 0.3 |
| Iron deficiency 6, % | 123 | 20.7 (16.8,24.7) | 36 | 23.4 (17.6,29.2) | 0.4 |
| Iron-deficiency anemia 7, % | 47 | 7.9 (5.5,10.4) | 18 | 11.7 (6.6,16.8) | 0.1 |
| Vitamin A deficiency 8, % | 4 | 0.7 (0.0,1.3) | 0 | - | - |

1 Ns are unweighted. Values presented are geometric mean (95% CI) or percent (95% CI). P values calculated for linear contrast tests (continuous variables) and Rao-Scott chi-square tests (categorical variables). Confidence intervals account for weighting and complex sampling design.

2 High MNP sachet coverage was defined as having reported receiving at least 90 sachets (3 boxes) every six months during the 12 month pilot - the minimum recommended dose per the updated 2016 WHO guideline (1), while low MNP sachet coverage was reported MNP sachet receipt below this threshold.

3 Hemoglobin adjusted for altitude.

4 Biomarker was regression-adjusted to a pooled country reference to correct for inflammation using CRP and AGP (12).

5 Anemia defined as altitude-adjusted hemoglobin < 11.0 g/dL (13).

6 Iron deficiency defined as inflammation-adjusted serum ferritin <12 μg/L (13).

7 Iron deficiency anemia defined as altitude-adjusted hemoglobin <11.0 g/dL and inflammation-adjusted serum ferritin <12.0 μg/L (13).

8 Vitamin A deficiency was defined as adjusted RBP <0.67 µmol/L in the endline sample. To find the population-specific RBP cut-point, we regressed RBP on retinol to determine the RBP equivalent of retinol <0.70 µmol/L based on the subsample of 39 children for whom serum retinol was assessed using HPLC from a second blood draw (14).

Abbreviations: AGP, ɑ-1 acid glycoprotein; CRP, C- reactive protein; MNP, micronutrient powder; RBP, retinol-binding protein.