Maternal Nutrition Outcomes in an Integrated Agriculture, Health and Nutrition Program in Western Kenya

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On behalf of the Mama SASHA team
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5 year, quasi-experimental, nutrition, agriculture and health linkages study in Western Kenya (2009-2014)

Can linking vitamin A rich orange-fleshed sweetpotato (OFSP) access and nutritional training to existing health services improve the consumption of vitamin A rich foods and improve maternal and child nutrition?

Integrated Partnerships: International Potato Center (CIP) in collaboration with PATH (International Health NGO), Univ. of Toronto, Emory Univ., CREADIS & ARDAP (2 Local Agricultural NGOs), MoA & MoH
1. Purposive selection and random allocation of health facilities
   • 4 intervention, 4 comparison facilities in Bungoma and Busia counties
2. Cross sectional baseline and endline surveys
   • **Objective**: Assess community level impact on diets and child nutrition
   • **Design**: 2 stage cluster randomized baseline / endline surveys in Mar-May 2011 and Mar-May 2014; Detailed costing data for cost-effectiveness analysis
3. Nested Cohort Study (COVA)
   • **Objective**: Assess individual level impacts on maternal and child nutrition
   • **Design**: Longitudinal study, 505 women from pregnancy to 9 months postpartum; Multipass 24 hour recalls conducted on 206 mother-infant dyads at 8-10 months postpartum. Intervention effects assessed with two level mixed effects organizational models or three level mixed effects growth models adjusted for clustering, repeated measures and relevant covariates
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<table>
<thead>
<tr>
<th>Data Type</th>
<th>Enrollment (10-24 wk)</th>
<th>Late third trimester</th>
<th>4m post-partum</th>
<th>9m post-partum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-demographics</td>
<td></td>
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<tr>
<td>Program uptake</td>
<td></td>
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<tr>
<td>Food security; dietary diversity; OFSP consumption</td>
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<tr>
<td>Knowledge of VA / nutrition; OFSP</td>
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<tr>
<td>Morbidity, health care utilization</td>
<td></td>
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</tr>
<tr>
<td>Anthropometry</td>
<td>Mothers</td>
<td>Mothers</td>
<td>Mothers&amp;Infants</td>
<td>Mothers&amp;Infants</td>
</tr>
<tr>
<td>Breastmilk retinol and carotenoids</td>
<td></td>
<td></td>
<td>Mothers</td>
<td>Mothers</td>
</tr>
<tr>
<td>Micronutrient status: RBP, ferritin, Tfr, CRP and AGP</td>
<td>Mothers</td>
<td>Mothers</td>
<td>Infants</td>
<td>Mothers&amp;Infants</td>
</tr>
<tr>
<td>Anemia</td>
<td>Mothers</td>
<td>mothers</td>
<td>Mothers</td>
<td>Mothers&amp;Infants</td>
</tr>
<tr>
<td>Multi-pass 24 hour recalls (subsample, Table 3)</td>
<td></td>
<td></td>
<td></td>
<td>Mothers&amp;Infants</td>
</tr>
</tbody>
</table>
COVA FINDINGS

1. Sweet Potato (SP) and Orange Flesheed Sweet Potato (OFSP) Production

2. Maternal Nutrition and Health Knowledge
   • Vitamin A / Vitamin A rich foods
   • ANC / delivery care
   • Optimal IYCF practices

3. Maternal Diets
   • Diet Diversity
   • Consumption of VA rich foods
   • VA intakes (subsample)

4. Maternal MUAC, vitamin A status and anemia
At enrollment (n=505):
- 29 intervention and 4 control women reported OFSP production in past year

At 9 months postpartum (n=384):
- 70% of intervention women produced OFSP compared to <5% of controls
- 92.7% of intervention women received vouchers for OFSP vines
  - Mean times received = 2.80 ± 1.2.
  - 13 women did not redeem any vouchers due to season, distance to the DVM or not being able to obtain permission to plant

Figure 1: Sweet potato production in previous year

![Bar chart showing sweet potato production](chart.png)
## FINDINGS: INCREASED NUTRITION & HEALTH KNOWLEDGE

<table>
<thead>
<tr>
<th>Index Scores</th>
<th>Control</th>
<th>Intervention</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enrollment Δ V1-V4</td>
<td>Enrollment Δ V1-V4</td>
<td></td>
</tr>
<tr>
<td>Total Nutrition and Health Knowledge</td>
<td>3.36±2.18 1.58±2.23</td>
<td>3.96±2.23 2.63±2.69</td>
<td>0.02</td>
</tr>
<tr>
<td>VA knowledge</td>
<td>0.63±1.20 0.13±1.22</td>
<td>2.03±1.39 0.99±1.52</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>IYCF knowledge</td>
<td>2.42±1.28 1.22±1.38</td>
<td>2.34±1.34 3.83±1.64</td>
<td>0.15</td>
</tr>
</tbody>
</table>

*p values estimated for intervention effect adjusted for repeated measures, clustering and baseline values

Table 1: Knowledge and vitamin A index scores increased from enrollment to 9 months postpartum among intervention mothers
**FINDINGS: GREATER CONSUMPTION OF OFSP**

![Bar chart showing any OFSP consumption in past 7 days](image)

**Figure 1: Any OFSP consumption in past 7 days**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment effect</th>
<th>Treatment time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Any OFSP</td>
<td>0.002</td>
<td>0.09</td>
</tr>
<tr>
<td>2. Days consumed</td>
<td>0.003</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

![Line chart showing days OFSP consumed](image)

**Figure 2: Days OFSP consumed**

- Late Pregnancy
  - 4 mos postpartum
- 9 mos postpartum

- Early Pregnancy
  - 4 mos postpartum

- Treatment: control vs. intervention
**FINDINGS: NO EFFECTS ON OVERALL DIET DIVERSITY**

### P value for outcomes

<table>
<thead>
<tr>
<th>Treatment effect</th>
<th>Treatment time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. VA rich fruits / veg</td>
<td>0.07</td>
</tr>
<tr>
<td>4. Diet Diversity Scores</td>
<td>0.61</td>
</tr>
</tbody>
</table>

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**Figure 3: Days consumed VA rich FV**

**Figure 4: Women’s Dietary Diversity Scores**

- **control**
- **intervention**
Table 2: Intervention mothers’ vitamin A intakes were significantly higher at 8-10 months postpartum (n=206)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Intervention</th>
<th>P value(^2)</th>
<th>Adjusted RR (95% CI)(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta carotene, mcg</td>
<td>1420.3 (921.0-2236.4)</td>
<td>1783.1 (1017.0-3582.6)</td>
<td>0.005(^a)</td>
<td>1292.3 (282.5, 2302.2); 0.027</td>
</tr>
<tr>
<td>Retinol, mcg</td>
<td>51.2 (40.4-68.4)</td>
<td>59.4 (35.9-76.9)</td>
<td>0.311(^a)</td>
<td>16.4 (-8.12, 40.9); 0.264</td>
</tr>
<tr>
<td>Vitamin A, IU</td>
<td>1526.0 (727.1-2588.3)</td>
<td>2298.7 (1006.8-5122.5)</td>
<td>&lt;0.001(^a)</td>
<td>5363.8 (1922.3, 8884.9); 0.002</td>
</tr>
<tr>
<td>Vitamin A, RAE</td>
<td>180.8 (135.2-248.1)</td>
<td>238.5 (156.2-379.5)</td>
<td>&lt;0.001(^a)</td>
<td>234.0 (37.5, 430.5); 0.017</td>
</tr>
<tr>
<td>Energy, kcal</td>
<td>2539.8 (2168.4-2894.1)</td>
<td>2585.5 (2122.0-3022.3)</td>
<td>0.667</td>
<td>33.7 (-148.2; 215.7); 0747</td>
</tr>
</tbody>
</table>
FINDINGS: LIMITED IMPACTS ON MATERNAL NUTRITIONAL STATUS

Figure 5: Maternal MUAC
- control
- intervention

Figure 7: Maternal RBP
- control
- intervention

P values for outcomes
<table>
<thead>
<tr>
<th>Treatment effect</th>
<th>Treatment time</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. MUAC</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>6. Hemoglobin</td>
<td>0.20</td>
</tr>
<tr>
<td>7. RBP</td>
<td>0.79</td>
</tr>
</tbody>
</table>
FINDINGS: LIMITED IMPACTS ON MATERNAL NUTRITIONAL STATUS

Figure 8. MUAC < 22cm, %

control intervention

Figure 9. Anemia, %

Figure 10. RBP < 1.17, %

P value for outcomes  Treatment Effect  Treatment time
8. MUAC < 22  0.01  0.46
9. Anemia  0.20  0.97
10. Low RBP  0.77  0.20
CONCLUSIONS

A nutrition and health linkages program that promoted OFSP and provided enhanced nutrition education was associated with:

- Greater OFSP production
- Greater improvements in VA knowledge among mothers
- Greater VA intakes among women
- Borderline improvements in maternal vitamin A status and anemia in pregnancy
STRENGTHS AND CHALLENGES

- Participatory impact pathway clarified theory of change and guided M&E strategy
- Pilot period and integration of lessons learned in PoCP
- Integrated trainings and feedback meetings with health and ag extension
- Operations research suggest activities worthwhile and acceptable to health, agriculture and community actors
- Multilevel modeling strategies produce robust estimates of effect

- Staff turnover and stipend cut demotivated CHWs
- Initial resistance by men / elders Engagement of CHWs
- Low attendance at mothers clubs
- Integrated trainings of health and ag extension
- Small number of clusters introduces analytical bias but mitigated with repeated measures
ONGOING & PLANNED

- Analysis of data from broader evaluation strategy to identify impacts on child nutritional status
- Quantify breastmilk retinol and beta-carotene and identify pathways from maternal intakes to infant status
- Apply structural equation modeling to quantify pathways of effect
- Finalize cost-effectiveness analyses
Thank you from the Mama SASHA Team

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Carol Levin, PhD | PATH & University of Washington
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Haile Selassie Okuku, MSc | International Potato Center
Moses Wamalwa | International Potato Center
Rose Wanjala, MPH | International Potato Center

Cornelia Loechl, PhD | UN-IAEA
Abdelrahman Lubowa, MSc | Consultant
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Hermann Ouedraogo, PhD | Consultant
Rikka Trangsrud, MPH | PATH, Nairobi
Yvonne Wangui Machira | Consultant
Numerous MPH, MSc and PhD students
Participants, vine multipliers, community health workers and health facility staff
Research assistants, enumerators and support staff
SUPPLEMENTAL SLIDES
PoCP West Kenya

**Area**

**Health and nutrition**
- Health facility staff trained in nutrition and counseling on Vit A and OFSP
- Health facility staff trained in how to use vouchers
- IEC counseling cards, leaflet and poster on healthy nutrition developed by APEDA Plus and distributed in ANCs and among CHWs
- Community health workers trained in good nutrition including contribution of Vit A and OFSP and in OFSP agronomy
- Community health workers trained in organizing sensitization campaigns on importance of Vit A and benefits of OFSP
- Community health workers trained in setting up and running pregnant women clubs

**Outputs**

- Facility health workers provide improved counseling for health and nutrition
- Health facility staff accept and use vouchers routinely
- Health facility staff correctly using IEC materials in their work
- CHWs provide improved counseling for health and nutrition
- CHWs encourage women to access OFSP vines and follow up on planting and provide basic agronomic advice
- Pregnant women clubs including OFSP operational by CHW

**Outcomes**

- More pregnant women continually using antenatal health care
- Pregnant mothers have improved knowledge of Vit A and benefits of OFSP and want to access vines
- Pregnant women, mothers and babies increased consumption of OFSP and other Vit A rich foods
- Pregnant mothers in PW clubs have improved knowledge of Vit A and benefits of OFSP and want to access vines
- More women and under twos with adequate Vit A status

**Seed Distribution**
- Secondary vine multipliers trained in quality multiplication and voucher system
- Agricultural extension agents and secondary vine multipliers trained to provide extension in OFSP production
- IEC calendar and flipchart about OFSP agronomy

**Farm practices**
- Extension workers and vine multipliers correctly provide advice on OFSP production
- OFSP demonstration plots at DVR level

**Crosscutting**
- Male community leaders trained to sensitize male household head about the importance of supporting women on ANC use and improved nutrition with OFSP
- Health workers and extensionists jointly trained in seed systems, nutrition
- Feedback meetings of stakeholders from health and agriculture sectors
- Field days to demonstrate OFSP production and nutritional benefits

**Next Users**

- CHW correctly using IEC materials in their work
- Secondary vines multipliers make healthy vines available
- Pregnant women and mothers using vouchers provided by health centers

**End Users**

- More women and under twos with adequate weight gain during pregnancy
- Reduced prevalence of underweight (weight for age) and stunting (height for age) of under twos

**Impact**

- More pregnant women and lactating mothers with adequate nutrition
- More women with increased consumption of Vit A rich foods
- More women with adequate weight gain during pregnancy
- Reduced prevalence of underweight (weight for age) and stunting (height for age) of under twos
### Characteristics of Mothers at Enrollment

<table>
<thead>
<tr>
<th>Socio Demographic Variables</th>
<th>Overall (n=505)</th>
<th>Intervention (n= 251)</th>
<th>Control (n= 254)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age, years</td>
<td>24.3 ± 5.5</td>
<td>24.1 ± 5.5</td>
<td>24.6 ± 5.5</td>
<td>0.326</td>
</tr>
<tr>
<td>Gestational age in weeks at enrollment</td>
<td>20.4 ± 5.1</td>
<td>20.5 ± 5.5</td>
<td>20.4 ± 4.7</td>
<td>0.717</td>
</tr>
<tr>
<td>Head of Household is Husband / Partner</td>
<td>432 (85.5%)</td>
<td>205(82.0%)</td>
<td>227(89.0%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Maternal Education, &lt; Primary</td>
<td>155(30.7%)</td>
<td>68(27.2%)</td>
<td>87(34.1%)</td>
<td>0.251</td>
</tr>
<tr>
<td>Mother is married/ partnered monogamous</td>
<td>399 (79.0%)</td>
<td>194 (77.6%)</td>
<td>205 (80.4%)</td>
<td>0.410</td>
</tr>
<tr>
<td>Maternal Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not work remuneratively</td>
<td>200 (39.8%)</td>
<td>120 (48.0%)</td>
<td>80 (31.4%)</td>
<td>0.000</td>
</tr>
<tr>
<td>Agriculture</td>
<td>168 (33.4%)</td>
<td>63 (25.2%)</td>
<td>105 (41.2%)</td>
<td></td>
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<tr>
<td>Salaried employment</td>
<td>25 (5.0%)</td>
<td>15 (6.0%)</td>
<td>10(3.9%)</td>
<td></td>
</tr>
<tr>
<td>Informal business</td>
<td>54 (10.7%)</td>
<td>17 (6.8%)</td>
<td>37(14.5%)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>56 (11.1%)</td>
<td>34(13.6%)</td>
<td>22(8.6%)</td>
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</tr>
<tr>
<td>Head of Household Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not work</td>
<td>68(13.5%)</td>
<td>47 (18.10%)</td>
<td>21 (8.2%)</td>
<td>0.000</td>
</tr>
<tr>
<td>Agriculture</td>
<td>104(18.7%)</td>
<td>31 (12.5%)</td>
<td>63 (24.7%)</td>
<td></td>
</tr>
<tr>
<td>Wealth / Asset Index Score</td>
<td>8.55 ± 1.77</td>
<td>8.54 ± 1.92</td>
<td>8.55 ± 1.62</td>
<td>0.99</td>
</tr>
<tr>
<td>Number of children &lt; 5 y*</td>
<td>1 (0, 1)</td>
<td>1 (0, 1)</td>
<td>1 (0, 2)</td>
<td>0.13</td>
</tr>
</tbody>
</table>

*presented as median (25th, 75th percentiles)
Characteristics of Mothers at Enrollment and Delivery

<table>
<thead>
<tr>
<th>Food Security and Nutrition at Enrollment</th>
<th>Overall</th>
<th>Intervention (n=251)</th>
<th>Control (n=254)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Food Insecurity Category</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure / mild</td>
<td>276 (55.1%)</td>
<td>131 (54.1%)</td>
<td>145 (57.8%)</td>
<td>0.2210</td>
</tr>
<tr>
<td>Moderate</td>
<td>102 (20.6%)</td>
<td>58 (24.0%)</td>
<td>44 (17.5%)</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>115 (23.3%)</td>
<td>53 (21.1%)</td>
<td>62 (24.7%)</td>
<td></td>
</tr>
<tr>
<td>Maternal RBP, µmol/L*</td>
<td>1.44 ± 0.3</td>
<td>1.42 ± 0.3</td>
<td>1.46± 0.3</td>
<td>0.245</td>
</tr>
<tr>
<td>Maternal RBP &lt;1.05 umol/L*</td>
<td>110 (21.8%)</td>
<td>54 (21.7%)</td>
<td>56 (22.0%)</td>
<td>0.104</td>
</tr>
<tr>
<td>Maternal ferritin &lt; 12mg/dL*</td>
<td>114 (22.6%)</td>
<td>63 (25.3%)</td>
<td>51 (20.0%)</td>
<td>0.155</td>
</tr>
<tr>
<td>Maternal Hb &lt; 11.0 g/dL</td>
<td>159 (31.5%)</td>
<td>80 (32.0%)</td>
<td>79(31.0%)</td>
<td>0.841</td>
</tr>
<tr>
<td>Maternal MUAC, cm (N=505)</td>
<td>26.0 ± 3.0</td>
<td>25.3 ± 2.5</td>
<td>26.8± 3.3</td>
<td>0.000</td>
</tr>
<tr>
<td>Birth Outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational age at delivery</td>
<td>39.6 ± 1.12</td>
<td>38.8± 3.6</td>
<td>39.2 ± 3.5</td>
<td>0.32</td>
</tr>
<tr>
<td>Infant weight within 1 week of delivery</td>
<td>3.42 ± 0.55</td>
<td>3.39 ± 1.03</td>
<td>3.37 ± 0.86</td>
<td>0.83</td>
</tr>
<tr>
<td>Infant sex, % Female</td>
<td>187 (46.8%)</td>
<td>94 (48.2%)</td>
<td>943 (45.4%)</td>
<td>0.57</td>
</tr>
</tbody>
</table>

*RBP and ferritin adjusted for inflammation using correction factor method; Anemia adjusted for altitude
• 505 women enrolled
• Retention rates were similar across treatment arms (76% and 77%) but differed across the 8 facilities (63% - 86%)
• Women retained to 9 months (n=384) were more likely to be partnered / married
• No other differences observed