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**Strengthening and Evaluating the  
Preventing Malnutrition in Children under  
2 Years of Age Approach in Burundi  
Summary Report**

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June 2018

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## Abbreviations and Acronyms

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|           |  |
|-----------|--|
| BCC       | behavior change communication                                |
| CRS       | Catholic Relief Services                                     |
| CSB       | corn-soy blend   |
| dL        | deciliter(s)   |
| FANTA     | Food and Nutrition Technical Assistance III Project          |
| g         | gram(s)  |
| Hb        | hemoglobin   |
| HIV       | human immunodeficiency virus                                 |
| IFPRI     | International Food Policy Research Institute                 |
| IMC       | International Medical Corps                                  |
| ISTEEBU   | Institut de Statistiques et d'Etudes Economiques du Burundi  |
| IYCF      | infant and young child feeding                               |
| NGO       | nongovernmental organization                                 |
| PM2A      | Preventing Malnutrition in Children under 2 Approach         |
| PRONIANUT | Programme National Intégré d'Alimentation et de la Nutrition |
| T18       | <i>Tubaramure 18</i>   |
| T24       | <i>Tubaramure 24</i>   |
| TNFP      | <i>Tubaramure</i> no food during pregnancy                   |
| USAID     | U.S. Agency for International Development                    |

## Summary

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*Tubaramure* was a Development Food Security Activity funded by U.S. Agency for International Development (USAID)'s Office of Food for Peace (FFP) and implemented by a consortium of NGOs led by CRS in eastern Burundi from 2010-2014. It followed the "Preventing Malnutrition in Children under 2 Years of Age" PM2A model, providing three major services: food rations, health services strengthening and behavior change communication for the improvement of nutrition and health behaviors. Program beneficiaries were mothers during pregnancy and the first 6 months postpartum and their children until 2 years of age. *Tubaramure* was evaluated via a comprehensive research program, including a cluster-randomized controlled impact evaluation. The program resulted in improvements in household food security, women's dietary diversity, and IYCF practices; a limited improvement in beneficiaries' nutrition and health knowledge and practices (with the exception of a large increase in bed net use); and increased availability of services for sick children and pregnant women. Child morbidity also decreased in the program areas. Overall, *Tubaramure* resulted in a 7.1 percentage points reduction in stunting compared to non-*Tubaramure* control areas. The evaluation noted a deterioration in the stunting rates in the control areas during the lifetime of *Tubaramure*, which highlights the protective effect of the intervention. The evaluation also showed an improvement in both maternal and child anemia. These findings suggest that food-assisted maternal and child health and nutrition programs that intervene during the first 1,000 days and that simultaneously address multiple determinants of undernutrition can protect poor families from economic, health, or other shocks in vulnerable countries such as Burundi.

## 1. Introduction

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*Tubaramure*—a “Preventing Malnutrition in Children under 2 Years of Age” (PM2A) program and U.S. Agency for International Development (USAID) multi-year development food assistance project—was implemented by a consortium of nongovernmental organizations (NGOs) in eastern Burundi from 2010 to 2014. The consortium was led by Catholic Relief Services (CRS), and the International Medical Corps (IMC), Caritas Burundi, and Food for the Hungry were the other consortium members. The project’s aim was to improve the health and nutritional status of pregnant and lactating women and children under 2 years of age through three core components: distribution of family and individual food rations, behavior change communication (BCC) sessions focused on improving health and nutrition-related behaviors, and attendance at preventive health services.

A comprehensive research program was integrated into the *Tubaramure* project. The research was conducted by the International Food Policy Research Institute (IFPRI) in collaboration with the consortium of NGOs implementing *Tubaramure*, and with funding from the Office of Food for Peace at USAID through the Food and Nutrition Technical Assistance III Project (FANTA). The impact of *Tubaramure* was evaluated using a cluster-randomized controlled trial with three treatment arms.

Beneficiaries in each treatment arm received BCC sessions, preventive and curative health services throughout the program, and a monthly household food ration composed of 12 kg of corn-soy blend (CSB)<sup>1</sup> and 1,200 g of fortified vegetable oil. In addition to the household ration, an individual ration was distributed for the beneficiary: a pregnant or lactating woman (0–5 months postpartum) received 6 kg of CSB and 600 g of oil, and a child 6–23 months received 3 kg of CSB and 300 g of oil. The treatment arms differed primarily by the timing and duration of food rations, to test the optimal length of provisions provided by the program: from pregnancy until the child was 24 months of age (referred to as the T24 arm), from pregnancy until the child was 18 months of age (T18), and from birth until the child was 24 months of age (TNFP). Households in the control communities did not receive program benefits, but they could access preventive and curative health services.

The program’s impact was assessed using three cross-sectional surveys (conducted in 2010, 2012, and 2014). The first cross-sectional study provided a baseline reference. The 2012 follow-up survey assessed the impact of *Tubaramure* following approximately 2 years of program implementation on children 0–23 months of age. The corresponding report focused on outcomes such as maternal health and nutrition-related knowledge and practices, including infant and young child feeding (IYCF) practices; maternal and child anemia; and child development. Knowledge and practice outcomes were assessed when the program was still being implemented to reduce recall bias. In addition, program impact on anemia was expected to be largest for mothers immediately postpartum and for young children. Impact on children’s motor development was expected to be largest among children 12–18 months of age, as this is when children attain independent walking. A detailed overview of these findings is provided in the 2012 follow-up survey (Leroy et al. 2014). The largest program impact on child linear growth (the main outcome of the study) was expected to be observed in children exposed to *Tubaramure* for the whole period from early pregnancy to 23 months of age. The first group of children to meet this condition were 24–41 months of age in October–December 2014, when the second follow-up survey was conducted (4 years after the baseline survey). None of the households in the 2014 follow-up were current beneficiaries, as the program ended 1 month before the follow-up survey started. The results of that survey were presented in the 2014 follow-up report (Leroy et al. 2017). In addition to presenting the impact on child linear growth, the 2014

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<sup>1</sup> While most FFP development assistance projects switched to CSB+ (which has an upgraded macro- and micronutrient formulation) by 2012, the *Tubaramure* project continued to use the older formulation of CSB to preserve the study’s integrity.

report presented the lasting impact of the program on outcomes such as knowledge, health practices, and dietary diversity (i.e., the impact after the program ended, also known as the *post-program* impact).

In this summary report, we review the impact<sup>2</sup> (in 2012) on intermediary outcomes along the primary program impact pathways that correspond to the three program components (i.e., the food component, the BCC component, and the health component); we assess to what extent this impact lasted after the program ended (i.e., in 2014); we then present the impacts on maternal and child nutrition, health, and development in 2014; and we discuss program and policy implications in the conclusions.

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<sup>2</sup> All impacts mentioned in this report were statistically significant unless indicated otherwise.

## 2. Program Impact Along the *Tubaramure* Pathways of Impact

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The three primary program impact pathways through which *Tubaramure* was expected to improve maternal and child nutrition and child development outcomes revolved around the three core components mentioned in the previous section. The food pathway was expected to improve these outcomes by increasing household availability of micronutrient-rich food through the provision of these foods and, in turn, increasing consumption of these foods and improving diet diversity<sup>3</sup>. The second pathway revolved around *Tubaramure*'s BCC component, which was expected to contribute to improving the outcomes by improving maternal knowledge of optimal hygiene, health, and nutrition practices and increasing adoption of optimal practices. The health pathway aimed to improve outcomes by improving the provision of preventive health services by health staff, and by increasing utilization of these services by pregnant and lactating women and children 0–23 months of age.

### 2.1 The *Tubaramure* Food Component

#### 2.1.1 Program Impact (2012 Survey)

The food component of the *Tubaramure* program provided micronutrient-fortified food rations to program beneficiaries and their households. These food rations were provided monthly and consisted of a household ration and an individual ration meant to be consumed by the woman while she was pregnant or when her child was under 6 months of age, and by the child when he or she was 6–23 months of age. The household ration consisted of 12 kg of CSB and 1,200 g of oil. The individual ration for pregnant and lactating women consisted of 6 kg of CSB and 600 g of oil, and for children 6–23 months of age it consisted of 3 kg of CSB and 300 g of oil. These rations were expected to increase availability of micronutrient-rich foods at the household level, improve household food security, and improve maternal and child diets.

The *Tubaramure* program was found to be well-known, and a large proportion (75 percent to 85 percent)<sup>4</sup> of eligible households were either previous or current program beneficiaries. When asked about the program benefits and activities, nearly all current beneficiaries mentioned the food rations. Notwithstanding the large distance to reach the distribution site (an average of 1.5 hours), missing a food distribution was rare, and nearly all participants reported that they received the CSB and oil ration as they expected.

As would be expected with a program providing large food rations to food-insecure households, *Tubaramure* had an important positive effect on household access to food as measured by the Household Food Insecurity Access Scale (Coates, Swindale, and Bilinsky 2007). The program reduced the percentage of severely food-insecure households by 9 to 18 percentage points. *Tubaramure* also led to a modest decline in the percentage of households with a dietary diversity score less than 4 (out of a possible 12), but the impact was only statistically significant in the T18 treatment arm.

*Tubaramure* had a small positive impact (ranging from 0.31 to 0.40 food groups out of nine) on the very limited diversity of mothers' diets. The largest impact for a single food group was found for legumes—a direct consequence of CSB<sup>5</sup> consumption in beneficiary mothers. The program also improved all four key indicators of complementary feeding practices. The largest impact was seen in the proportion of children

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<sup>3</sup> Using private funds, CRS added a home gardening and animal-raising component. Since these activities were not part of the *Tubaramure* program at the time of the baseline survey, data on these outcomes were not collected.

<sup>4</sup> Ranges refer to the values found for the different intervention groups.

<sup>5</sup> As indicated in the 2012 report, CSB contributed to the starchy staples and legumes group when we assessed women's (and children's) dietary diversity.

consuming iron-rich foods, including iron-fortified foods such as CSB (an increase of 27 to 40 percentage points), which appeared to be directly related to the increased intake of CSB. A more modest positive impact (5 to 26 percentage points) was found for the other three key complementary feeding practice indicators: the proportion of children receiving the minimum recommended number of meals, the proportion of children receiving the minimum dietary diversity (which appears to be a consequence of CSB consumption), and the percentage of children consuming a minimally acceptable diet. Many key program impacts, such as the improvements in household food security, women’s dietary diversity, and IYCF practices, appear to be a direct consequence of receiving the food rations.

### **2.1.2 Post-Program Impact (2014 Survey)**

Interestingly, *Tubaramure* had a lasting positive effect on several outcomes along the food pathway after the program ended. The program increased the percentage of food-secure households by 4–6 percentage points (as measured by the Household Food Insecurity Access Scale). The program also increased household dietary diversity by 0.3 food groups and reduced the percentage of households that consumed fewer than four food groups (out of a possible 12) by around 12 percentage points. The post-program impact on the diversity of mothers’ diets was of the same magnitude as that observed in 2012 (0.4 food groups out of a possible nine).

There are different pathways by which *Tubaramure* could have had these effects after the program ended. Households may have used some of the freed-up resources to acquire food stocks or to invest in productive assets, which led to greater availability of food or to higher household income and expenditure, respectively. Both of these types of investments could have led to the improvements in food security and dietary diversity seen in the second follow-up survey. Through its BCC component, the program may have also changed the beneficiaries’ understanding of the importance of healthy diets. This, in turn, may have led to changes in the prioritization of diverse diets and an increase in the number of food groups consumed. Assessing the (relative) strength of these and other pathways,<sup>6</sup> however, was beyond the scope of this study.

## **2.2 The *Tubaramure* Behavior Change Communication Component**

### **2.2.1 Program Impact (2012 Survey)**

*Tubaramure*’s BCC strategy was designed to encourage the adoption of best practices in health, hygiene, and nutrition. It was implemented by program staff, locally hired *Tubaramure* health promoters, and leader mothers who were program beneficiaries selected by their fellow beneficiary mothers to teach them. Leader mothers were expected to train the beneficiary mothers in care groups (which meet every 2 weeks) on the topics that they had most recently learned about from the health promoters.

When asked about the program benefits and activities, four-fifths of all current beneficiaries mentioned BCC sessions, but attendance at the care groups was only about half of what was intended by the *Tubaramure* program design.<sup>7</sup> Exposure to cooking demonstrations was even lower. Only half the mothers who had ever participated in a care group reported that a cooking demonstration had ever been offered.

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<sup>6</sup> Another possible pathway was community gardens, which *Tubaramure* promoted through the BCC component. This program component, however, was introduced too late for its coverage and impact to be assessed.

<sup>7</sup> Beneficiaries reported having attended, on average, 4.3 meetings in the 4 months preceding the first follow-up survey in 2012. As care groups were supposed to meet every 2 weeks, the expected number of care groups attended was eight.

### **Health, Nutrition, and Hygiene Knowledge**

*Tubaramure*'s impact on maternal nutrition and health knowledge was mixed at the time of the 2012 follow-up survey. The program had no statistically significant effect on mothers' very limited knowledge of danger signs during pregnancy or for childhood illnesses. However, *Tubaramure* substantially reduced the large proportion of mothers who previously believed that children's breast milk, liquid, and food intake should be reduced when they are ill. The percentage of mothers who erroneously believed that intake should be reduced during convalescence was considerably smaller, and no program impact was found for this outcome.

The program clearly increased awareness of vitamin A- and iron-rich foods, but did not change the percentage of mothers who knew the consequences of vitamin A or iron deficiency. *Tubaramure* had a positive (albeit modest) effect on mothers' limited knowledge related to complementary feeding: it reduced the percentage of mothers who thought liquids and foods other than breast milk should be introduced before 6 months of age, but did not reduce the common belief that complementary foods should be introduced after 6 months of age. The program did, however, substantially increase the percentage of mothers who knew the correct feeding frequency for infants and young children.

The program also dramatically increased the percentage of mothers who knew handwashing with soap is important after toilet use and before feeding a child. No impact was found, however, on knowledge regarding how to protect children from worm infections or how to purify drinking water.

The limited impact of the program on nutrition and health knowledge might be due to several factors. Mothers were exposed to only about half of the intended BCC sessions. In addition, *Tubaramure*'s BCC strategy suffered substantial delays in the design and rollout of the module on complementary feeding. As a consequence, only a fraction of mothers had been exposed to this module at the time of the 2012 follow-up survey. Finally, the process evaluation (conducted from late 2011 to early 2012) showed that the leader mothers had limited technical expertise and teaching skill (Olney et al. 2013). Better delivery and utilization of the *Tubaramure* BCC strategy might thus have resulted in a larger impact on maternal knowledge, better health and nutrition practices, and a larger impact on nutritional status.

### **Health, Nutrition, Hygiene, and Sanitation Practices**

*Tubaramure* did not have a statistically significant impact on the reported attendance at growth monitoring services or any of the other preventive health care utilization outcomes. The 2012 survey found a concerning decline in growth monitoring attendance (from one-third to one-fifth of children in the past 2 months) and in the percentage of children being fully vaccinated for their age (from 70 percent to 63 percent). The percentage of children who received vitamin A supplementation in the past 6 months was similar at baseline and follow-up (57 percent and 60 percent, respectively). The program increased reported bed net<sup>8</sup> use in mothers during pregnancy (among women who had recently given birth) and in the 6 months after giving birth, and in children under 6 months of age.

*Tubaramure*'s impact on feeding practices was mixed. Breastfeeding practices among this population were largely optimal in many aspects at baseline, and they continued to improve between baseline and both follow-up surveys. Likely due in part to the largely optimal practices at baseline, *Tubaramure* did not have a statistically significant effect on any of the studied breastfeeding practices, with the exception of an increase in the percentage of children who were still breastfed at 1 year of age. As discussed in section 2.1, the program led to a significant improvement in complementary feeding practices.

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<sup>8</sup> Note that no overall impact on bed net use was reported in the 2012 report. Further in-depth analyses found significant effects in certain subgroups (Leroy, Olney, and Ruel 2016).

*Tubaramure* had a modest positive impact on household hygiene and sanitation practices. The percentage of households that treated their water increased only slightly, but a large impact was found on the percentage of households that composted their trash (rather than discarding it in a public space). Composting was promoted through a household poster provided to all *Tubaramure* households.

Soap, which most households owned, was rarely used at key hand-washing times. The effect of *Tubaramure* was limited to a significant, positive impact on the proportion of mothers reporting the use of soap after defecating. Using a spot-check observation of hands, hair, clothes, and faces of mothers and children, *Tubaramure* was found to somewhat improve cleanliness in all four domains. The percentage of households with clean exteriors and interiors (as observed in a spot check) also improved.

### **Child Health**

*Tubaramure* had a strong beneficial effect on child morbidity, as it protected children from the overall morbidity increase observed in the control group between baseline and the 2012 follow-up. Statistically significant program effects were found for general morbidity symptoms and for key symptoms such as fever, loss of appetite, cough, watery diarrhea, difficulty drinking, and vomiting. The program also had a significant positive impact (in the T24 and TNFP groups) on the proportion of children who received medication to treat a fever. This indicates that in addition to the general increase in this outcome in all study groups—which might be due to *Tubaramure*'s health strengthening activities (see next section)—the program also increased the demand for this service at the household level in the treatment arms. No significant impact was found for any of the other curative care-seeking behaviors, which were found to be largely inadequate. For instance, only about 43 percent of children with diarrhea had received oral rehydration salts, and a similar percentage reported reducing their children's liquid intake. Additionally, a fifth of mothers with a severely ill child did not seek care.

## **2.2.2 Post-Program Impact (2014 Survey)**

### **Health and Nutrition Knowledge**

The program's post-program effect on mothers' very limited knowledge of danger signs for childhood illnesses was limited to a small increase in the percentage of mothers mentioning rapid breathing.

*Tubaramure* had a lasting effect on mothers' knowledge of breastfeeding, providing liquids, and appropriate feeding for sick children; consistent with the 2012 finding, no post-program effect was found for knowledge regarding feeding a child recovering from illness.

*Tubaramure* had a clear post-program impact on mothers' awareness of vitamin A-rich foods and had a modest positive post-program effect on the percentage of mothers who mentioned impaired vision as a consequence of vitamin A deficiency. The post-program impact on awareness regarding iron-rich foods was limited to mentioning CSB; the program did not change the percentage of mothers who knew the consequences of iron deficiency.

*Tubaramure*'s post-program effect on knowledge regarding the age of introduction of solid foods and liquids other than breast milk was in line with what was documented in the first follow-up: it increased the percentage of mothers who knew that liquids (other than breast milk) and foods should not be introduced before 6 months of age, but did not reduce the percentage of mothers who wrongly believed that complementary foods should be introduced after 6 months of age. No meaningful post-program impact on other feeding-related knowledge (i.e., consistency of complementary foods, feeding frequency, and eating without help) was found.

The program's positive effects on the percentage of mothers who could mention key hand-washing times remained. A modest post-program effect was observed on maternal awareness of appropriate worm-

protection methods (but this effect was not observed in 2012). Consistent with the first follow-up, no significant effect was observed on knowledge of appropriate methods for purifying drinking water.

### **Health, Hygiene, and Sanitation Practices**

*Tubaramure* did not have a post-program impact on any of the preventive health care utilization outcomes assessed in the survey.

*Tubaramure*'s impact on household hygiene and sanitation practices, documented in 2012, was still observed in the post-program period. The impact on the percentage of households treating their water remained modest; a large post-program effect was found on the percentage of households that composted trash. Bed net ownership and use increased dramatically between baseline and follow-up across all study groups, but no post-program impact on bed net ownership or use was found. Most households still owned soap, but its use at key hand-washing times was rare; the post-program impact was limited to the use of soap after defecating and after cleaning a child who had defecated. *Tubaramure*'s effect on improving the cleanliness of the hands, hair, clothes, and faces of mothers and children and the cleanliness of household interiors disappeared. Only the impact on the percentage of households with clean exteriors remained.

### **Child Health**

The protective effects of the program on child morbidity (in children 24–41 months of age) were observed even after *Tubaramure* had ended. Whereas many of the reported morbidity symptoms in the control group increased over time, a decline was observed in the treatment groups. Statistically significant post-program effects were found for general morbidity symptoms and for key symptoms such as fever, convulsions, difficulty drinking, loss of appetite, cough, difficulty breathing, and watery diarrhea. No post-program effects on curative care seeking were found.

## **2.3 The *Tubaramure* Health Component**

The health service strengthening component was implemented to improve the quality of preventive and curative care at primary health care centers. The *Tubaramure* program strengthened existing health services through training health staff<sup>9</sup>, as well as by providing key supplies for implementing health services. Health supplies included equipment for prenatal care (e.g., vaginal speculum, *Pinard* obstetric stethoscope), labor and delivery (e.g., delivery table), growth monitoring (e.g., salter scale, infant scale), and curative care (e.g., thermometer, sterile equipment). This program component was implemented in all health centers (i.e., in both treatment and control *collines*). The lack of a control group prevented attributing improvements in health center characteristics directly to *Tubaramure*.

### **2.3.1 Program Impact (2012 Survey)**

#### **Health Services**

By the first follow-up survey, more health centers staffed A2-level nurses (the highest qualified staff members mandated for health centers), and more (though still only two) staffed an A2-level laboratory technician. Overall, key service components for sick children, children with diarrhea, and pregnant women improved over time, but there were several exceptions to this general trend. First, zinc supplementation was rarely offered to children with diarrhea. Some health centers failed to use curative

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<sup>9</sup> IMC provincial technical assistants provided medical training for two nurses and two nurses' assistants working within each district health center and two doctors working within each district hospital. IMC largely focused its efforts on training nurses and paramedics working in the health centers because they were the frontline staff for each community. They received annual training on prenatal care, postnatal care, growth monitoring and promotion, integrated management of childhood illness, and community management of acute malnutrition. IMC also trained the provincial and district health officers to monitor health care activities within the health centers and hospitals to ensure that services were implemented according to the components of the IMC training.

consultations (i.e., when treating sick children) as an opportunity to monitor preventive care status (i.e., chart weight, immunizations, and vitamin A supplementation every 6 months). This was a missed opportunity for families who did not otherwise seek preventive health care services for their children.

The availability of prenatal services improved somewhat from baseline to follow-up. Iron folate distribution was still not universal, but malaria and HIV testing were available to pregnant women at every health center, suggesting a strong potential to provide laboratory tests when other key components (e.g., training and supplies) are in place. Other basic laboratory services, such as urine and anemia tests, were offered in only one health center. Medication and immunization shortages were common and likely hampered adequate service provision.

### ***Impact on the Use of Pre-, Peri-, and Postnatal Health Care Practices***

*Tubaramure* had no statistically significant impact on the already high percentage of mothers who received prenatal care, but increased the “demand”<sup>10</sup> for prenatal services: it increased the total number of prenatal visits, led to a substantial increase in the percentage of mothers who had at least four prenatal visits, and caused women to have their first prenatal visit a week to 10 days earlier in pregnancy. The only possible “supply” effect on the types of prenatal services received was for providing a blood sample. The use of key services, such as checking blood pressure or testing urine, remained unacceptably low.

An alarming finding in the 2012 follow-up was the dramatic drop in the proportion of women taking iron during pregnancy. The positive changes over time in the use of malaria prevention (i.e., sleeping under a bed net and receiving anti-malarial medication) observed in all groups suggested a possible *Tubaramure* supply effect.

The percentage of mothers delivering at a public health facility increased dramatically, which might be a consequence of *Tubaramure*'s health strengthening activities. Positive effects were also found for the percentage of births attended by a trained health professional, the percentage of newborn infants immediately cleaned and wrapped (strategies to prevent hypothermia), and the percentage of newborns weighed at delivery. The program had no supply or demand effect on the very low percentage of women taking iron after giving birth.

## **2.3.2 Post-Program Impact (2014 Survey)<sup>11</sup>**

### ***Health Services***

At the second follow-up, all but one of the health centers staffed A2-level nurses and three centers also staffed an A2-level laboratory technician. The availability of services for sick children, children with diarrhea, and pregnant women continued to improve. Specifically, health education, the evaluation of preventive care status (i.e., chart weight, immunizations, and vitamin A supplementation every 6 months), and available services for the treatment of diarrhea (i.e., oral serum, onsite intravenous solution, and zinc supplementation) for children had improved dramatically by the 2014 follow-up. The availability of prenatal services improved such that, with the exception of niclosamide for *taenia* deworming, all surveyed components of services for pregnant and lactating women were universally available in all 11 health centers.

<sup>10</sup> As pointed out in the first follow-up report, the program could have improved health care utilization through two distinct pathways: increasing the supply of services in the health centers (through the *Tubaramure* health strengthening activities) and increasing the demand for these services (through the *Tubaramure* BCC strategy). We refer to these types of impact as the “supply” and “demand” effects.

<sup>11</sup> As the 2014 follow-up survey focused on older children, data on the use of pre-, peri-, and postnatal health care seeking were not collected.

HIV testing for pregnant women continued to be available at every health center at the 2014 follow-up, but the availability of urine and anemia tests for pregnant women was still low (fewer than half of the health centers). Blood tests for malaria, as part of the health centers' postnatal services, were still universally available.

All health centers generally stocked key vaccines, micronutrients, and supplements, but stock ruptures continued to be common.

### 3. Impact on Child Development and Maternal Nutrition and Child Nutrition

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The three program pathways described above that revolve around *Tubaramure*'s core components (i.e., food, BCC, and health) were expected to work together to improve child development and maternal and child nutrition outcomes. Impacts on these outcomes are discussed below.

#### 3.1 Child Development

As seen for many other outcomes in this study, the highest-attained motor and language development milestones among children 4–23 months of age declined in all study groups between 2010 and 2012. *Tubaramure* had a protective effect on the highest-attained motor milestone in the TNFP group and on the highest-attained language milestone in the T24 and T18 groups.

The post-program impact on child development was limited to children 24–29 months of age: a positive effect on the highest-achieved motor milestone (in the T24 group) and highest-achieved language milestone (in all treatment groups combined, and in the T18 and T24 groups) was found in this age group.

#### 3.2 Hemoglobin Level and Anemia

The first follow-up survey documented a steep increase in the prevalence of anemia in mothers across all study arms. However, the program had a significant protective effect on maternal anemia of 4.2 to 7.5 percentage points (Leroy, Olney, and Ruel 2016). A similar result was found in children 6–23 months of age, with an overall increase from 2010 to 2012 in the prevalence of anemia (to around 73 percent) and a protective effect of the program on reducing the decline in children's hemoglobin (Hb) by 0.24 to 0.56 g/dL in treatment groups compared with the control group. *Tubaramure* did not have a post-program protective effect on these outcomes in children 24–41 months of age.

#### 3.3 Child Linear Growth

As explained above, the impact on child linear growth was only assessed in the second follow-up survey. A steep increase in the already high prevalence of stunting in the control group was observed from 2010 to 2014 (68.2 percent to 74.8 percent). *Tubaramure* had a large post-program protective effect on stunting of 5.5 percentage points (all treatment groups combined). A statistically significant effect was also seen in the T24 group (7.1 percentage points) and in the T18 group (5.2 percentage points; marginally significant), but the effect did not reach significance in the TNFP group. The difference in impact was not statistically significant between treatment arms, but our findings suggest that full program exposure from pregnancy to 24 months led to the largest impact on linear growth in the beneficiary population in Burundi. This finding answers the central research question of the Burundi study, which was to determine the optimal program duration to improve linear growth.

It seems plausible that *Tubaramure*'s effect on linear growth is attributable to the program-related improvements in IYCF practices (i.e., the minimum recommended number of meals, the percentage of children receiving the minimum dietary diversity, and the percentage of children consuming a minimally acceptable diet) and *Tubaramure*'s effect on reducing child morbidity.

The largest linear growth impact was found in children 24–29 months of age (estimated protective effect of 16.3 percentage points). No significant impact was found in the other age groups.

The (largely) limited effect of *Tubaramure* on child development and child linear growth to children 24–29 months of age was surprising. Our data showed that it was not due to higher program participation in this age group compared with older children. The quality of program implementation (which was not

measured in the impact evaluation surveys) might have improved over time as program staff gained experience. Under this scenario, the youngest children in the 2014 follow-up survey would have benefited from a higher-quality program than the older children in the sample. An alternative explanation is that the program's impact could not be sustained in the absence of the program (i.e., when the program benefits were no longer received).

## 4. Conclusions

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Using a large-scale, cluster-randomized controlled trial, we demonstrated that the food-assisted maternal and child health and nutrition program *Tubaramure* had a positive impact on child and maternal nutrition outcomes and child development. The impact study showed that program exposure for the entire 1,000-day period led to a greater impact on stunting in this highly food-insecure population. The documented program impact on intermediary variables (i.e., diet, morbidity, and bed net use) suggests plausible pathways of impact.

Analyses of *Tubaramure*'s impact on maternal and child hemoglobin and anemia confirmed that the program had significant impacts on several known determinants of Hb concentration and anemia (Leroy, Olney, and Ruel 2016). We showed that *Tubaramure* had a significant impact on dietary diversity, consumption of iron-rich foods, morbidity, and fever—all factors along the hypothesized impact pathways for Hb and anemia—for child Hb. Program impacts on dietary diversity, consumption of iron-rich foods, and bed net use were also documented for maternal anemia.

Our evaluation results highlight the critical importance of a strong BCC component. For example, our process evaluation showed that the change in bed net use in mothers and children was likely due to the program's BCC<sup>12</sup>: "Today we put a mosquito net to protect against the mosquitoes thanks to the lessons from *Tubaramure*" (female beneficiary, Olney et al. 2013). The improvements in nutrition and health practices might have been even greater if the participation of beneficiary mothers in BCC activities had been higher and if some of the BCC aspects had been strengthened. The process evaluation showed that leader mothers did not always have the required technical expertise or teaching skills and that many beneficiaries were not exposed to messages on complementary feeding practices because of delays in BCC rollout. In a Guatemala PM2A program, linking the receipt of food rations to participation in BCC sessions led to very high levels of participation, and programs may consider this or other measures to improve program participation. In addition, programs need to assess to what extent leader mothers with low levels of schooling have the necessary skills to effectively transmit complex nutrition and health messages, to adjust the training of leader mothers to match their skills, or to re-assess the suitability of the care group model as the program's BCC approach.

The severe deterioration in several nutrition, health, and development outcomes between the baseline and follow-up surveys are of great concern. Our findings suggest, however, that food-assisted maternal and child health and nutrition programs that intervene during the first 1,000 days and that simultaneously address multiple determinants of undernutrition can protect poor families from economic, health, or other shocks in vulnerable countries such as Burundi.

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<sup>12</sup> The program did not distribute bed nets.

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