EconomiX

https://economix.fr/

It Takes a Village to Raise a Child. Impact Evaluation of the Training for Volunteers in Health and the Nutritional Recovery Cycles in West Guatemala

Document de Travail
Working Paper
2020-14

Juliana Yael Milovich
Elena Villar

UMR 7235

EconomiX - UMR7235
Université Paris Nanterre
Bâtiment G - Maurice Allais, 200, Avenue de la République
92001 Nanterre cedex

Email : secretariat@economix.fr

Université Paris Nanterre

It Takes a Village to Raise a Child.

Impact Evaluation of the Training for Volunteers in Health and the Nutritional Recovery Cycles in West Guatemala

Juliana Yael Milovich*[1] and Elena Villar†[2]

[1]University Paris Nanterre

[2]Catholic University of Milan

Abstract

The highest rates of child undernutrition in Guatemala are found in Western regions, where more than half of the children under five are stunted and almost 20% underweight. However, despite the large incidence of undernutrition in the country, there is no robust evidence of its determinants, effects and possible solutions. Our study analyses the impact of a program implemented by the Foundation FUNDAP in West Guatemala, Volunteers in Health, on the nutritional health of children under five years of age. We provide new evidence on how training women at the community level to provide information on infants' nutrition to mothers, together with the monitoring of children's growth and the supply of food supplements, contributes to significantly reduce the probability of children being underweight in West Guatemala.

Keywords: Child Undernutrition · Women's Training · Health Programs · Impact Evaluation

JEL Classification: I38, J1, I18

The views presented in this work are those of the authors and do not necessarily reflect those of the Foundation FUNDAP. The authors declare that they have no relevant nor material financial interests that relate to the research described in this paper.

We are deeply thankful to Antoine Terracol, Lucia Corno, Cécile Couharde, Akiko Suwa-Eisenmann, Roxana Maurizio, Philippe De Vreyer, two anonymous reviewers, participants at the internal research seminar of Oxford Poverty and Human Development Initiative (OPHI) from the University of Oxford, at the 31st Conference of the European Association of Labour Economist, at the seminar on Applied Economics of Latin America of the Institute of Hight Studies of Latin America (IHEAL) from the University Sorbonne-Nouvelle, and participants at the internal seminar of the research centre DIAL from the University Paris Dauphine, for valuable comments and suggestions; and all the staff working in the Foundation FUNDAP that implements the program Volunteers in Health for giving us the opportunity to collaborate with them in evaluating the impact of their program on children's nutritional health in West Guatemala, as well as for the help that they have provided us throughout the analysis and that has allowed us to get closer to the reality of Guatemala.

*juliana.milovich@parisnanterre.fr

†elena.villar@unicatt.it

1 Introduction

We are still far from a world without malnutrition. Indeed, different forms of malnutrition coexist in many countries. On the one hand, after a prolonged decline, the number of hungry people in the world is growing. On the other hand, overweight and obesity are becoming a serious concern, also in developing countries (FAO, 2018). In a time where food availability, quality and security are at risk, children are paying the higher price. Undernutrition is still the most prevalent form of malnutrition among children. According to UNICEF, in 2017, 151 million kids under five were stunted, while 51 million suffered from wasting.[1]

Nearly two out of five stunted children live in South Asia, while one in three lives in sub-Saharan Africa. Latin America and the Caribbean have percentages of stunted children which are far behind the South Asian and sub-Saharan African levels[2], with a unique exception: Guatemala. Guatemala is the only country in the American continent where the percentage of stunted children is higher than 30%. More precisely, 46.5% of Guatemalan children under five are chronically undernourished and 12.6% suffer from global undernutrition (MSPAS and INE and Segeplán, 2017). It is well known that undernutrition, especially in early years, may result in higher susceptibility to illnesses and potential loss in intellectual quotient, which may translate in lower cognitive skills and productivity in adult years (Imai et al., 2014).

Despite the huge incidence of undernutrition among Guatemalan children, there is no robust evidence of its determinants, effects and possible solutions. To the best of our knowledge, only two works have attempted to face this issue in this country. One focuses on the determinants of undernutrition in general, the other on the possible consequences of a diet poor in proteins and vitamins. Marini and Gragnolati (2003) simply describe the relationship between child, maternal, household and community characteristics and children's nutritional status. Using data from the ENCOVI/INE 2000 survey and standard multivariate regression techniques, they show a strong association between children undernutrition, among which stunting prevails, and socioeconomic, geographical and ethnic factors. They found that undernutrition in Guatemala is concentrated among the poor, the least educated households, the rural population, and indigenous people. According to them, actions to face undernutrition in this country should focus on the areas of health, access to basic services, education, and nutritional interventions. In particular, they underline the relevance of community-based programs. Maluccio et al. (2009), instead, used a more robust approach to study the effect of an early childhood nutritional intervention on adult economic outcomes. On the basis of an intent-to-treat model, they found that the intervention, which consisted in the random provision of nutritional supplements to children, had long lasting positive effects in terms of higher grades, higher scores in both reading and comprehension tests and non-verbal cognitive ability tests.

According to these findings, a lack of appropriate nutritional knowledge and micro-

[1] https://data.unicef.org/topic/nutrition/malnutrition/

[2] 9.6% on average, versus, respectively, 35% and 34% (UNICEF and WHO and World Bank, 2018)

nutrients availability for infants and young children are key determinants of child undernutrition, with long lasting consequences. We are able to provide new evidence on the relevance of nutritional education and food supplementation for kids in Guatemala thanks to the availability of unique information on the program Vounteers in Health, which aims at improving mothers' knowledge on feeding practices and child health, together with the provision of food and vitamins supplements. The program, implemented since 2001 by the Foundation FUNDAP, targets the most vulnerable population living in the Western regions. These are the areas where chronic and global undernutrition reach respectively 40% and 80% of children under five years of age.

One of the main characteristics of the program is that it operates at the community level. Individuals living in the village who have at least a primary level of education are encouraged to follow a full-time course in infant nutrition and basic nursing in order to become a qualified volunteer in health able to sustain mothers during the first years of life of the child, usually becoming the closest reference mothers have to help them raise their children. Indeed, after having completed the training, passed exams and acquired official diplomas, these volunteers start to provide supports through a program called Nutritional Recovery Cycles. During six months, once per-month, they visit mothers, give them guidance on how to feed their children, provide food and vitamin supplements and perform basic measurements to verify the growth process of the child. Despite being open to both men and women, the volunteers are in large majority female. Acquiring this specific knowledge and being able to transmit it to mothers results in potential empowerment of women in two main ways. First, by giving the power of knowledge in this critical area of the country, where ignorance about fertility, birth control methods, hygiene and nutrition is still high. Second, by giving them the chance to activate themselves in the labor market, having acquired additional education and specific competences in the health field.

For the first time since the implementation of the program Volunteers in Health in 2001, the effectiveness of the project has been fully and scientifically evaluated. Two types of analyzes have been carried out in order to show how the program Volunteers in Health and the Nutritional Recovery Cycles can improve the nutritional conditions of girls and boys in western Guatemala. In the first one, we focus on the universe of children visited by the volunteers from 2015 to 2018 to provide evidence on how children improve their nutritional health outcomes as the recovery cycle goes on. The outcomes of interest are the standard measures defined by the World Health Organization (WHO) of child undernutrition in terms of z-scores (stunting, wasting, underweight).[3] We also estimate the average effect of participating in a nutritional recovery cycle, controlling for children's time-invariant unobserved characteristics. In a second step, we rely on additional data from the last National Maternal and Children's Health Survey[4] of 2014/2015. This allows us to build a reliable control group of children living in municipalities close to the treated ones, but who are not under the program. Specifically,

[3]Please, refer to Appendix A for a detailed description of these measures.

[4]Encuesta Nacional de Salud Materno Infantil (ENSMI), which is comparable to the Demographic and Health Survey.

we compare health outcomes of children who were monitored by volunteers in health in 2015 with those of children who lived in close municipalities where volunteers did not operate.

The main results obtained in the first analysis suggest that, after two visits from the beginning of the recovery cycle, the probability of a child to be underweight significantly drops, and in the last visit s/he receives by the volunteers this probability is 21 percentage points (p.p.) lower with respect to the timing in which s/he was first measured, on average. Moreover, when controlling for age, time trends, and individual time-invariant unobserved heterogeneity, we find that completing a nutritional recovery cycle reduces the probability of being (severe) underweight by 8.6 p.p. (5.1 p.p.) and wasted by 3.5 p.p., on average. Despite finding such a positive and strong reduction in the probability of having low weight-for-age, no impact has been detected in the probability of being stunted. The results of the analysis performed using the individual indicators of weight (in kilos) and height (in centimeters), show a significant increase in the child's weight from the second visit and with each additional visit, until reaching almost 1 additional kilogram by the end of the nutritional recovery cycle, compared to the weight the child had the first time s/he was measured, on average. The height also increases significantly from the third visit, to reach around 1.1 centimeters more with the last visit. However, the increase in height is not enough to significantly reduce the likelihood of the child facing a condition of low height for her/his age, perhaps because the six month that the cycle lasts is a relatively short period of time, mainly for children over two years of age.

Additionally, when controlling for a large set of observable characteristics that allow us to mitigate concerns of selection bias, the results from the analysis done for the year 2015 using a control group as counterfactual, suggest that the program was significantly effective in reducing the probability that girls and boys entering the nutritional recovery cycles suffer from low weight for their age. More precisely, we find that the probability that a child between 10 and 59 months of age suffered from underweight in 2015, was significantly reduced by 23.6 p.p. when s/he was visited by the volunteers. All these results are robust to several specifications and a falsification test.

Our paper belongs to the stream of literature analyzing the relationship between mothers' knowledge and child outcomes in developing countries. Most of this literature focused on the role played by general education on children's health. Glewwe (1999) found that, in Morocco, schooling plays a fundamental role for mothers since it indirectly allows them to be able to get health knowledge, which, in turn, is the most important skill that mothers have to take care of their children's health. Chou et al. (2010), instead, studied the effect of a general increase in mothers' education on child health. They evaluated a policy intervention which took place in Taiwan in 1968 and extended compulsory education from 6 to 9 years and opened over 150 new junior schools at a differential rate among regions. They found that mothers' schooling causes favorable infant health outcomes. An increase in schooling lowers the probability that an infant will be born light or will die in the neonatal or post-neonatal periods. Imai et al. (2014) found that increasing mothers' education relative to fathers is associated with better nutritional status of children in rural India.

There is much less evidence of the effect of specific knowledge on infant feeding and children's health, a gap in the literature that we contribute to fill. An example similar to ours is by Fitzsimons et al. (2016), who studied a program aimed at providing information on child nutrition to mothers is rural Malawi. Also in this case, trained local women visited mothers both before and after the birth of the child and provided information on infant feeding. They found evidence of improvements in children's diet and household food consumption, in particular an increase of protein-rich foods and fruits and vegetables. These improvements lead to children's better physical growth. To the extent of the current study, we are not able to distinguish the specific impact of each of the components of the nutritional recovery cycle – transfer of knowledge on nutritional health to mothers, monitoring of children's growth and supply of vitamin supplements. Following the experience of the coordinator of these programs at the Foundation FUNDAP, the most important factor in the process of nutritional recovery is the education and the support the mother receives. If she puts into practice the information received, she will provide the child with the corresponding dose of vitamins and improve care practices. This, in turn, will significantly help the child gain weight and height, breaking the vicious circles of disease. In line with this, other studies such as Paes-Sousa and Santos (2009), Gertler (2004) and an analysis from the National Department of Planning in Colombia (Rojas et al., 2007), have analyzed the impact of conditional cash transfer (CCT) programs in Brazil, Mexico and Colombia, respectively, on children's health indicators.[5] Although they all have found that these programs seem to be effective in improving children's nutritional health, they are not able to disentangle the effect of each of the components: budget improvement, parental education on nutrition, nutritional supplements and growth monitoring. Nonetheless, the sinergy between a larger supply of health facilities, the change in dietary patterns and the additional cash to poor families might underline the results found (Cecchini and Soares, 2015).

The structure of the paper is as follows. Section 2 is dedicated to the description of the training program and the main characteristics of the Volunteers in Health. In section 3 we present the data and the descriptive statistics of the children from the complete available sample, as well as from the sample used for the analysis. Section 4 shows the empirical strategy, while section 5 presents the main results obtained from the analysis. In section 6 we report some robustness checks and section 7 concludes.

2 The Training of Volunteers in Health

This section is dedicated to the description of the training program and the main characteristics of its participants.

[5] Please, refer to Table 15 in Appendix C for more detailed information on these studies

2.1 Purpose and Structure of the Training

The program Volunteers in Health has been implemented since 2001[6] by the Foundation FUNDAP. The motivations behind its development were twofold. First, the high rates of maternal and infant morbidity and mortality in Guatemala.[7] Second, the need to respond to the poor coverage of health services and lack of qualified staff at the community level. To partially solve both concerns, the Foundation FUNDAP designed a vocational capacity building program aimed at training qualified figures in the areas of fertility, pregnancy, child care, and nutritional counseling within communities. It additionally provides knowledge on birth control and hygiene at the individual and household levels.[8]

The program is currently implemented in rural and urban communities of the departments located in the North-West and South-West regions of Guatemala: Huehuetenango, Quetzaltenango, Retalhuleu, San Marcos, Sololá, Suchitepéquez and Totonicapán.[9] The communities where the program is implemented respond to three requirements: there is a sufficient number of people interested in enrolling the program; interested people fulfill basic educational requirements; and the acceptance of the program implementation by the mayor of the community. If these requirements are met, interested potential participants must follow a 12 hours course on the purpose and structure of the program. After this course, official enrollments are made. The training consists of a total of 134 hours over 11 months. The first 120 hours are dedicated to formal classes[10], while the remaining 14 hours are dedicated to case analyses, visits to health institutions, and practice in medical centers. At the end of the training program, participants must take written examinations and get official diplomas.

After obtaining the diploma, volunteers start to provide their counseling services within the communities. These services may take different forms, from awareness campaigns on health at the community level, to domestic visits to mothers and children in case of need. For the purpose of this work we will focus on a specific service: the Nutritional Recovery Cycles. These are programs aimed at monitoring and supporting children's growth process. Each cycle lasts 6 months. During this period of time, children are visited once per month by volunteers, who, in addition to giving mothers nutritional and health guidelines, also provide a food and vitamins supplement called *Incaparina*. Incaparina consists of the mixture of a cereal and a

[6]Unfortunately, reliable collection of data only started in 2015.

[7]In the early 2000s, the under-five years of age mortality rate was 50 deaths per $1,000$ live births (UNICEF, 2013).

[8]Moreover, given the critical situation that Guatamala is facing in terms of agricultural production and climate changes, it recently started to give information on sustainable consumption and community development.

[9]Please, refer to Appendix B for a description of some characteristics of the departments. The program Volunteers in Health is not implemented in the department of Quiché since the Foundation FUNDAP does not have trained staff in that region. Nonetheless, qualified staff within the Foundation is in charge of monitoring children in severe health conditions in the area. Therefore, and since we have nutritional information on children that live in some municipalities of Quiché, we include this department in the analysis, as well as in the detailed description of the departments.

[10]The most relevant topics of formal classes are: women's health, fertility, pregnancy and pregnancy-related complications, labor and delivery, newborn care, mothers and children's nutrition, most common diseases in children, hygiene, community health, and prevention and mitigation of natural disasters.

legume (corn and soy flour) to obtain an adequate balance of essential amino acids. It is also reinforced with a scientifically developed micro-nutrient mixture of vitamins[11] and minerals.[12] During the 6 months period of the nutritional recovery cycle, mothers are given the equivalent of 3 portions of 120 milliliters of Incaparina per day and per child as an additional source of food for their children who enter the nutritional recovery cycle.[13] So far, the doses are the same, for children in conditions of severe and moderate under-nutrition. Moreover, children's height and weight are monitored at each visit.

2.2 Volunteers in Health: Main Characteristics

We have information on the volunteers in health from 2015 to 2017. Table 1 shows descriptive statistics on their main characteristics: average age, percentage of volunteers by marital status, by occupation and by departments, as well as the exact number of volunteers per year of enrollment. All these characteristics are presented making a distinction between female and male volunteers.

The number of participants enrolled in the program has decreased over time, from 988 in 2015 to 931 in 2017. The large majority of participants, around 90%, are female. The average age of women is 28 years old, while that of men is 30. Most of volunteers are single: 55% of women and 63% of men. A larger share of women is in a couple, such as married or cohabiting, 43% versus 37% of males. The fraction of separated/divorced or widow is extremely low, especially among men. The large majority of women, around 60%, is a housewife. The proportion of men enrolled in any kind of studies is larger (32%) than that of women (20%). Men are also well represented among farmers (19%) and dealers (11%). We also observe that the departments with the highest share of volunteers in health are Quetzaltenango, San Marcos and Totonicapán. The smallest percentage of volunteers is located in the department of Sololá and they have not reached yet the department of Quiché.

Table 2 shows the shares of female volunteers by educational attainment as compared to the average educational levels of women in Guatemala. This is to show how women participating to the program have, on average, a higher level of education than average women in Guatemala, and aim to acquire additional specific education through the participation to the training program. In an area where the share of illiterate individuals is still high[14], this represents a good signal on how this program is also helping women to acquire more education, one of the main indicators of female empowerment.

3 The Recovery Cycle Program: Descriptives

The purpose of our analysis is to evaluate the impact that the training project for Volunteers in Health and the Nutritional Recovery Cycles provided by the trained volunteers, have on

[11] Vitamin A, B1, B2, B12, D.

[12] Folic acid, niacin, iron, zinc, and calcium.

[13] The nutritional supplements are assigned by children and not by family. If there are two children in the nutritional recovery cycle, each one will receive 3 portions of 120ml of Incaparina per day.

[14] see Appendix B for more details

Table 1: Summary Statistics: Volunteers in Health

	(1) Women	(2) Men
Age, years	28.3	30.2
Marital Status		
Married/Cohabiting, %	43.5	36.9
Separated/Divorced, %	1.0	0.4
Single, %	55.0	62.7
Widow, %	0.5	0.0
Occupation		
Housewife, %	55.0	0.0
Student, %	19.9	31.6
Dealer, %	3.0	10.7
Farmer, %	0.1	18.3
Others, %	21.9	39.5
Department		
Huehuetenango, %	3.8	9.9
Quetzaltenango, %	33.8	25.5
Retalhuleu, %	14.5	11.4
San Marcos, %	21.2	21.7
Sololá, %	0.6	0.0
Suchitepequez, %	10.0	9.9
Totonicapán, %	16.1	21.7
2015	899	89
2016	755	89
2017	846	85
Observations	2500	263

Source: statistics produced from the raw data available from the Foundation FUNDAP.

the nutritional health of children in the western regions of Guatemala. To do this, we use two samples of study: a first one consisting of all the children monitored by the volunteers between 2015 and 2018 for which we have complete anthropometric information during the nutritional recovery cycle; and a second one that corresponds to a sub-sample of girls and boys treated by the volunteers during 2015 for which we have complete anthropometric and household-level information, and which includes information on the girls and boys in the control group. This second sample uses available data from the National Maternal and Children's Health Survey 2014/2015 to build the control group.

In this section, we provide descriptive information on the full sample of children participating in the nutritional recovery cycle as well as on the sub-sample of treated and control children used for the second analysis.

3.1 Universe of Children Participating in the Nutritional Recovery Cycle

The data used in the first analysis, which has been provided by the Foundation FUNDAP, is full information on the anthropometric measurements of children under five years of age

Table 2: Educational attainment of female volunteers in health as compared to average women in Guatemala

	(1) Female Volunteers	(2) Guatemalan Women
No school %	4.97	18.40
Primary incomplete	8.48	19.50
Primary complete %	18.40	16.60
Technical incomplete %	6.12	16.20
Technical complete %	27.36	20.80
Secondary incomplete %	8.68	3.40
Secondary complete	21.04	5.10
University incomplete %	4.24	.
University complete %	0.72	.

Source: statistics on female volunteers is produced from the raw data available from the Foundation FUNDAP and on Guatemalan women from the National Institute of Statistics (Instituto Nacional de Estadística).

that the volunteers have monitored from 2015 to 2018. Table 3 reports the most relevant characteristics of these children. They are aged between 1 and 60 months and are 26.7 months on average, that is, two years and 3 months. The percentage of girls is higher than that of boys, 64.4%. Around 80% of children in the sample are stunted, 44.8% severely, while around 49% are underweight.

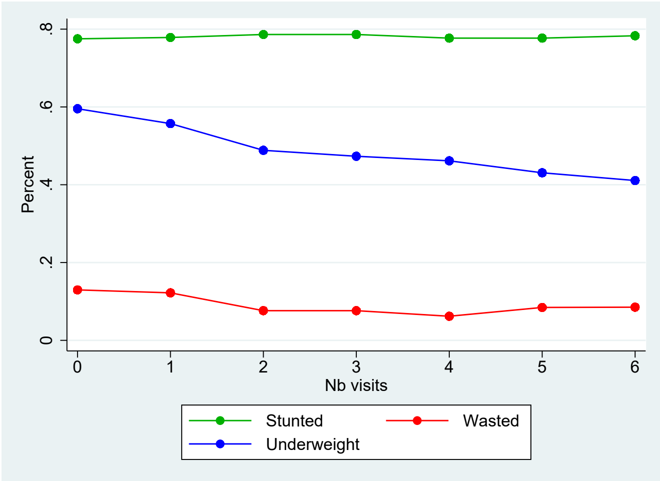
Table 3: Descriptives on the universe of children participating in the nutritional recovery cycle, 2015 - 2018

	(1) Mean	(2) SD	(3) Min	(4) Max
Age, months	26.7	13.6	1	60
Female,%	64.4	0.5	0	1
Nb visits	4.1	3.5	0	20
Weight, kgs	9.5	2.1	4.5	15.9
Height, cms	78.2	8.7	52	100
Underweight, %	48.5	0.5	0	1
Stunting, %	77.4	0.4	0	1
Wasting, %	8.8	0.3	0	1
Severe underweight, %	15.0	0.4	0	1
Severe stunting, %	44.8	0.5	0	1
Severe wasting, %	2.4	0.2	0	1
Observations		1,033		

Source: statistics produced from the raw data available from the Foundation FUNDAP.

In Figure 1 we present the share of children who are stunted, underweight and wasted within one nutritional recovery cycle, which, we recall, lasts 6 months, with one visit per month. We observe that the share of children that suffer from underweight tends to decrease throughout the cycle, which already suggests that the program seems to alleviate this specific form of undernutrition. In fact, the share of underweight children decreases from 60% when they enter the program to 40% at its end.

Figure 1: Share of children who are stunted, wasted and underweight throughout one nutritional recovery cycle



Source: statistics produced from the raw data available from the Foundation FUNDAP.

In Figure 2 we represent the share of children monitored by the volunteers in health that suffer from low weight for their age, by municipalities and departments from 2015 until 2018.

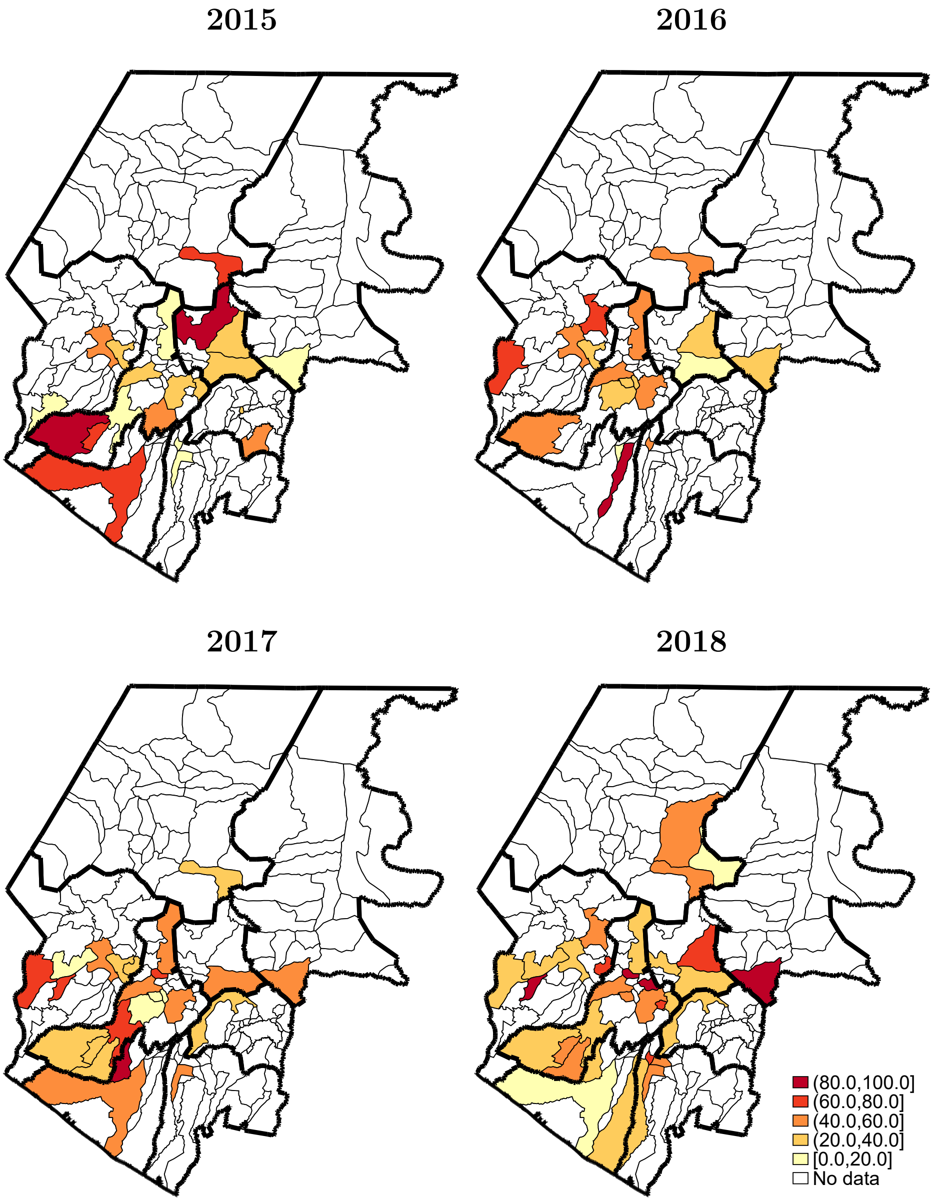
We observe that the number of municipalities in which the volunteers in health work has increased during this period of time. The departments of Quetzaltenango and Retalhuleu are those were the volunteers are more present, whereas the departments of Huehuetenango, Quiché, Sololá and Suchitepéquez are those where volunteers reach less. At the same time, we can observe that in some municipalities such as those in the South of Quetzaltenango (municipality of Coatepeque and Flores Costa Cuca), in the North of Totonicapán (municipality of Momostenango), in the West-Center of Retalhuleu (municipality of Retalhuleu) and in the South of Huehuetenango (municipality of Huehuetenango), the share of children that suffered from underweight in 2015 attained between 60% to 100% of the total number of children that were monitored. Nonetheless, we note that these percentages have reduced significantly until representing between 0% to 20% of the children monitored in 2018. These observations give further anecdotal evidence on the relevance that the program has on the nutritional health of the children under five years of age in West Guatemala.

3.2 Sub-Sample of Children: Treated and Control Groups

In order to improve the evaluation of the Volunteers in Health program and the service on Nutritional Recovery Cycles they provide, we need to rely on additional sources of data. Since there is no information on children that were not treated by the volunteers in health, we use the National Maternal and Children's Health Survey (ENSMI) 2014/2015 to build a reliable control group, which we use as comparison.

As already said, data on the treated sample is available for 2015, 2016, 2017 and 2018. On the other hand, data on the control sample is available for 2014 and 2015. We focus our analysis on 2015 since this is the only common year for which we have data on both groups. We also focus the main analysis on the North-West and South-West areas of Guatemala, since

Figure 2: Share of children under five monitored by the volunteers in health with low weight-for-age



Source: statistics produced from the raw data available from the Foundation FUNDAP.

these are the areas where the Foundation FUNDAP is currently reaching. The treated sample is composed of children that have entered the program on nutritional recovery cycles – and thus have been monitored by volunteers in health – and for which we have full anthropometric data and information on household characteristics.[15] The control sample is composed of children from the same departments that live in municipalities where Volunteers in Health do not reach. Therefore, children in the control group are not monitored by them.[16] Furthermore, we restrict the analysis to children who fall within the same age range, which is between 10 and 59 months.

Table 4: Summary Statistics: treated and control groups

Explicative variables	**Treated**	**Control**	**Difference**
Household's characteristics			
Improved sanitation, %	47.5	86.8	(***)
Access to drinking water, %	78.1	69.8	(**)
Ownership of animals, %	80.3	64.8	(***)
Good quality of housing materials, %	2.9	56.4	(***)
Child's characteristics			
Age, months	31.9	33.5	()
Gender: girl, %	56.2	48.1	(*)
Ever vaccinated, %	91.2	91.0	()
Dependent variables			
Underweight, %	35.0	16.0	(***)
Stunting, %	80.3	64.0	(***)
Wasting, %	3.7	0.5	(***)
Observations	137	1,549	

Notes: *** p<0.01, ** p<0.05, * p<0.1.
Source: statistics produced from the raw data available from the Foundation FUNDAP and in the last National Maternal and Children's Health Survey (ENSMI) 2014/2015.

We end up with a treated group of 137 children and a control group of 1,549. Table 4 summarises descriptive statistics for the main variables used in the analysis[17] and gives information on the significance of the difference between group averages. We note that, on average and based on the observable characteristics, groups are significantly different with the exception to the share of children that have ever been vaccinated, which reaches 92% of the children in the sample, as well as the average age of children in the sample, that is two years and a half. Related to household characteristics, we observe that, on average, the share of the population that has access to improved sanitation[18] is larger in the control group (86.8% versus 47.5%), whereas the treated group enjoys more availability to safe drinking water (78.1%

[15] This information is the one provided in Table 4

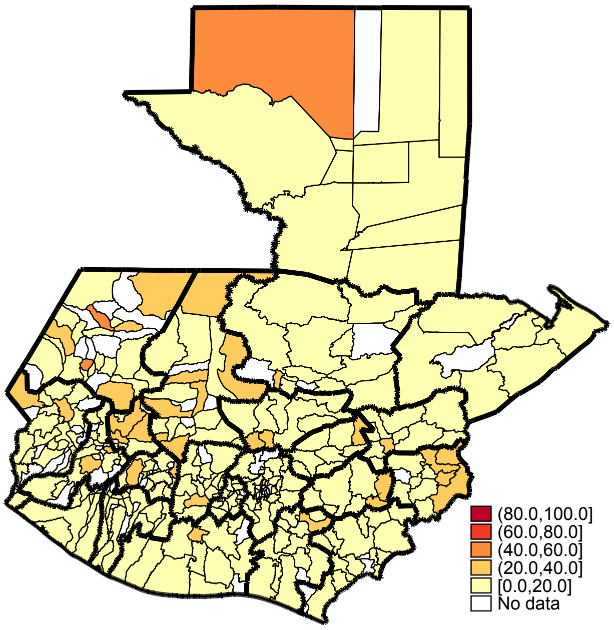
[16] We have proceeded as such because in the survey data we don't have information on whether children entered or not the nutritional recovery cycle and, thus, we are not confident on their treatment status. However, we know in which municipalities of the North-West and South-West regions the volunteers do not work and these are the ones (as long as survey data is available) that are included in the control group.

[17] Please, refer to Appendix A for detailed information on these variables. Information on the ethnic origins of the mother are not available in the data from the Foundation FUNDAP and we are not able to proceed with this identification by the type of animals they have. Information on the area (rural/urban) where the child lives is also not available.

[18] Improved sanitation facilities, improved drinking water sources and good dwelling are coded following the Millenium Development Goals Guidelines (United Nations, 2009).

versus 69.8%) and ownership of animals (80.3% versus 64.8%), on average. Also, the share of girls is slightly larger in the treated sample (56.2%) than in the control one (48.1%).

Figure 3: Share of children under five with low weight-for-age in 2014/15 in Guatemala



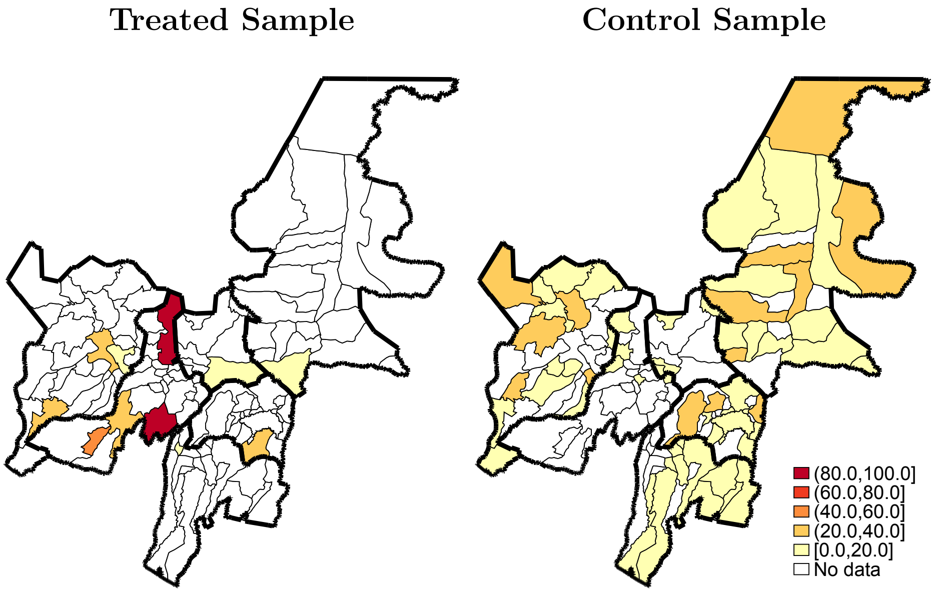
Source: statistics produced from the raw data available in the last National Maternal and Children's Health Survey (ENSMI) 2014/2015.

The three outcomes in Table 4 correspond to the standard measures of undernutrition as defined by the World Health Organisation (WHO, 2010) and De-Onis and Blossner (1997): wasting (low height-for-weight), stunting (low height-for-age) and underweight (low weight-for-age).[19] Their values for the treated sample correspond to those calculated from the last measurement done by the volunteers. We use this measure and not the first one in order to make sure that all children have received the treatment at least once, regardless of the number of times she or he has received it.[20] We observe that, on average, the share of children between 10 and 59 months that face a situation of undernutrition, as measured either by low weight-for-age, low height-for-age or low height-for-weight, is significantly larger in the treated sample than in the control group.

Figure 3 shows the share of children under five suffering from underweight (or global malnutrition) in all Guatemala. In order to be able to provide figures at the national level, the data used for this map is entirely from the ENSMI 2014/15 survey. As previously stated, the highest shares of prevalence are found in the West-North and West-South regions, where most of the indigenous people live. In these regions, the rate of children facing low weight for their age reaches 40 to 60% in some municipalities, compared to the rest of the country where the average share is not higher than 40% (except from a municipality in the region of Petén in the North).

[19]Please, refer to the Appendix A for a detailed description of how these measures are calculated.
[20]The treatment is here considered to be at least one visit from the volunteers.

Figure 4: Share of children 10-59 months with low weight-for-age in 2015 in West Guatemala



Source: statistics produced from the raw data available from the Foundation FUNDAP and in the last National Maternal and Children's Health Survey (ENSMI) 2014/2015.

In Figure 4 we map the share of children between 10 and 59 months who suffered from low weight-for-age in 2015 in the treated and the control municipalities within the 6 departments of analysis. In this case, the data used for these figures is the one used in the analysis – i.e., the data in the treated sample comes from the Foundation FUNDAP and the data in the control sample from the ENSMI 2014/15 survey. The number of treated municipalities is 13, whereas the control municipalities are 63. We observe that in some municipalities of the treated group 80% to almost all children followed by the Volunteers in Health faced a situation of underweight in 2015.

4 Empirical Strategy and Identification

Our empirical strategy is divided into two different parts. We begin by performing two exercises on the full sample of treated children from 2015 to 2018 to estimate, first, the evolution of the probability of being (severely) stunted, (severely) underweight and (severely) wasted by visit received by the volunteers within a full recovery cycle; and second, its average when children have completed a full recovery cycle, compared to that when the cycle is not yet completed.

We then move to a different approach, consisting in selecting a sub-sample of treated children and building a reliable control group to provide an evaluation of the effectiveness of the nutritional recovery cycle program in fighting infant undernutrition among the most vulnerable areas of Western Guatemala.

4.1 Part 1: Analysis on the Full Sample of Treated Children

We begin our analysis by studying the evolution of the probability of being (severely) stunted, (severely) wasted or (severely) underweight at each visit that makes up a nutritional recovery cycle. More specifically, for each treated child, we indicate as $v = 0$ the first time s/he is visited by the volunteer, who evaluates her/his health status and decides that the child enters the nutritional recovery program. Afterwards, the child will be monitored by the volunteer, who will also provide the mother with the required dosage of Incaparina and the necessary information to take care of the infant's nutritional needs, once per month during 6 months until the cycle is completed.

We estimate a linear probability model for child i, measured by the volunteer at visit v in year t, specified as follows:

$$Y_{ivt} = \sum_{j=1}^{6} \gamma_j \cdot \mathbf{1}[j = v] + \sum_{k} \alpha_k \cdot \mathbf{1}[k = age_{it}] + \sum_{s} \nu_s \cdot \mathbf{1}[s = t] + \varepsilon_{ivt} \tag{1}$$

where Y_{ivt} is a binary variable equal to 1 if the child suffers from (severe) stunting, (severe) wasting or (severe) underweight at visit v in year t, and 0 otherwise; v (first term of the right-hand side) are binary variables for each visit the child has received; and binary variables for the age (in years) of the child (second term) and for the year in which the child is measured by the volunteer (third term), are included. ε_{ivt} is the error term assumed of mean 0 and clustered at the child level[21]. Estimations of the probability of begin stunted, underweight or wasted are done relative to the time in which the child is monitored for the first time and enters the program – i.e., relative to the first visit $v = 0$. Including age dummies in the regression allows us to control for common age trends, while the year dummies account for common time trends.

To deepen the analysis, we seek to measure the average probability of being (severely) stunted, (severely) wasted or (severely) underweight when the child has completed a full recovery cycle, compared to that when the cycle is not completed[22]. In this specification, we restrict our analysis to the sample of children who have completed just one nutritional recovery cycle – i.e., children who have been visited more than six times, likely because of poor initial health conditions, but who have not completed a second recovery cycle. As a robustness check we extend the sample to include also those children that have completed two cycles.

We estimate a linear probability model for child i, measured by the volunteer at visit v in year t, specified as follows:

$$Y_{ivt} = \nu_t + \theta_i + \delta T_{iv} + X'_{it}\zeta + \varepsilon_{ivt} \tag{2}$$

where Y_{ivt} is a binary variable equal to 1 if the child suffers from (severe) stunting,

[21] In this specification we did not include a full set of individual fixed effects to avoid a problem of collinearity. Indeed, there would be a perfect linear relationship between the indicators of time relative to the first visit, time dummies and the individual fixed effects. To be able to include individual fixed effects we would need to omit two years dummies instead of one. But we did not embrace this solution since we have no reason to assume that two years are equal.

[22] In practice, we build an indicator equal to zero from visit zero up to the fifth, and equal to one starting from the sixth visit.

(severe) wasting or (severe) underweight at visit v in year t, and 0 otherwise; X'_{it} is a set of covariates that include the age of the child (in years) with a quadratic specification; ν_t are year fixed effects, accounting for common time trends to all children measured in the same year; and θ_i are individual fixed effects, measuring the time-invariant unobservable characteristics at the child level. T_{iv} is a binary variable equal to 1 if the child i has been monitored at least seven times by the volunteers (the first, and then six more within the recovery cycle), and hence has completed at least one recovery cycle, and 0 otherwise. ε_{ivt} is the error term assumed of mean 0 and clustered at the child level. The coefficient δ is the parameter of interest, measuring the average probability of being stunted, wasted or underweight when a child has completed a full recovery cycle, compared to that when the cycle is not yet completed.

4.2 Part 2: Analysis on the Sub-Sample of Children in the Treated and Control Groups

As we have indicated previously, the goal of this second analysis is to analyse whether the program of Volunteers in Health and the service on Nutritional Recovery Cycles the volunteers provide, has a significant impact in improving nutritional health of children under five in West Guatemala. In order to do this, one would think that the simplest way to do it is to compare the health status of those children who have received the treatment – i.e., who have been monitored by the volunteers – with the health of those who have not – i.e., the control sample. As we have seen in the previous section, the average prevalence of underweight in the treated municipalities is 19 percentage points (p.p.) higher than in the control ones and this difference is statistically significant at 1% confidence level. Proceeding with this naive comparison might make us conclude that the program of the Foundation FUNDAP make children sicker. However, we should not take this result as granted since what this comparison might be telling us is that children monitored by the volunteers are probably less healthy, on average. Indeed, even after having received the treatment at least once, children might still be suffering from under-nutrition, although they might be better off than they would have been if they hadn't received the treatment.

This information suggest that the assignment of the treatment is not random, or said in other words, that the treatment is not independent of the health status of children. This creates a problem of selection bias (Angrist and Pischke, 2008). To describe it more precisely, we denote the variable measuring the treatment each child i receives from the volunteers in health as D_i, which is equal to 1 if the child receives the treatment and 0 otherwise (i.e., children in the treated sample receive a value of 1 and those in the control group receive a value equal to 0). The outcomes of interest, which are the different measures of undernutrition as defined by the WHO ((severe) wasting, (severe) stunting and (severe) underweight), are denoted as Y_i. If the child suffers from any kind of undernutrition, Y_i is equal to 1 and 0 otherwise. Therefore, the question is whether D_i has an impact on Y_i or not.

Ideally, one would like to compare the potential health status of child i if s/he is monitored by the volunteers, Y_{1i}, with her/his health potential status had s/he not been monitored by them, Y_{0i}. This last potential outcome is called the counterfactual and gives information on what the health status of a treated child i would be if s/he had not received the treatment. The difference between the two potential outcomes, $Y_{1i} - Y_{0i}$ is said to be the causal effect of the program Volunteers in Health. Unfortunately, we can never see both potential outcomes for any child and, thus, we need to rely on the comparison of the average health of those children that received the treatment and those that did not, in order to learn about the impact of the program implemented by the Foundation FUNDAP.

However, we have seen few lines above that this naive comparison provides us with poor information about the effect of the program as long as the assignment of the treatment is not independent of the health status of children. Formally, the observed difference in average nutritional status conditional on being monitored by the volunteers in health can be written as follows:

$$\underbrace{E[Y_i|D_i=1]-E[Y_i|D_i=0]}_{\text{Observed difference in average health}} = \underbrace{E[Y_{1i}|D_i=1]-E[Y_{0i}|D_i=1]}_{\text{ATT}} + \underbrace{E[Y_{0i}|D_i=1]-E[Y_{0i}|D_i=0]}_{\text{Selection bias}} \quad (3)$$

where the first term on the right side of the equation is called the *average treatment effect on the treated (ATT)*, or in other words, the *average causal effect of the program Volunteers in Health and the Nutritional Recovery Cycles on those children who were followed and treated by the volunteers*, which indeed measures the difference between the two potential outcomes of child i; and the second term on the right side of the equation is the *selection bias*, which measures the difference in average nutritional outcome between those who were treated by the volunteers in health and those who were not. As we have seen in table 4, this difference is significantly large and positive – 19 p.p. – and it might mask the effect of the program, which we would expect to reduce the probability of children being undernourished, thus a significant negative coefficient.

When the treatment D_i is randomly assigned, Angrist and Pischke (2008) suggest that the selection bias term disappears making the treated and control groups comparable. In this case, a simple regression of Y_i on D_i would thus give the *average causal effect of the program Volunteers in Health and the Nutritional Recovery Cycles on those children who were followed and treated by the volunteers*. Nonetheless, when this is not the case, it is important to include in the regression (of Y_i on D_i) a variety of control variables X_i that could help explain the difference in nutritional outcomes between treated and non-treated children. That is, to account for those relevant observable variables that could help explain what causes a child to enter the nutritional recovery cycle and therefore be treated by the volunteers.

This leads us to the *Conditional Independence Assumption* (CIA) or what it is also called *selection on observables* because these variables X_i that might help explain the *selection of a child to receive the treatment* are assumed to be known and observed (Angrist and Pischke, 2008). The CIA is a core assumption that tells us that, conditional on the observed characteristics X_i, the selection bias disappears and hence, the comparison of average nutritional outcomes across treated and non-treated children has a causal interpretation. Formally, the

CIA can be written as:

$$\{Y_{0i}, Y_{1i}\} \perp D_i | X_i \tag{4}$$

which means that, conditional on the observable variables X_i, the potential nutritional outcomes of treated and non-treated children are independent of the treatment assignment and, thus, both groups can be indeed compared.[23] If the CIA holds, equation 3 can be re-written as follows:

$$\underbrace{E[Y_i|X_i, D_i = 1] - E[Y_i|X_i, D_i = 0]}_{\text{Observed difference in average health}} = \underbrace{E[Y_{1i} - Y_{0i}|X_i]}_{\text{ATT}} \tag{5}$$

and comparing potential average nutritional outcomes between treated and non-treated children, conditional on the observable characteristics, gives us the average treatment effect of the program Volunteers in Health and the Nutritional Recovery Cycles on those children who were followed and treated by the volunteers.

Because the treatment assignment happens in this study at the municipality level (cf. previous section), the regression that we estimate is a linear probability model[24] for the child i that lives in department d, measured at time t and is specified as follows:

$$Y_{idt} = \alpha_d + \gamma_t + \underbrace{\beta}_{ATT} Treatment_{id} + X_i'\zeta + \varepsilon_{idt} \tag{6}$$

where Y_{idt} is a binary variable equal to 1 if the child suffers from (severe) stunting, (severe) wasting or (severe) underweight and 0 otherwise. $Treatment_i$ is a dummy variable equal to 1 if the child i living in department d is monitored by the volunteers in health and equal to 0 if the child lives in the same department but in a municipality where the volunteers don't reach, thus he is not monitored by the volunteers. The coefficient β measures the average treatment effect of the program on the treated children (ATT). We include dummy variables at the department level, measured by the coefficient α_d, accounting for the specific time-invariant characteristics of each department and γ_t are dummy variables for months when the interview and measurement of the child occurred, which account for time trends common to all children interviewed during the same month. X_i' is the vector of covariates at the individual and household level. And ε_{idt} is the error term assumed of mean 0.[25]

It is relevant to control for the characteristics at the department level since the Foundation FUNDAP particularly works in departments with higher prevalence of child undernutrition. For instance, we show in figure 4 that there is higher prevalence of underweight

[23]It is relevant to note that random assignment of the treatment ensures that the characteristics X_i are balanced across the treated and the control group. In this case, the simple comparison of potential nutritional status of children between groups would provide the average causal effect of the program. This usually happens with experimental data, and not with observational data, as the one that is used in this analysis.

[24]Another possible method to estimate the average treatment effect on the treated is the Instrumental Variables. However, we are not able to have a good instrument from the available information provided by the Foundation FUNDAP and hence, we rely on a control strategy to claim the causal interpretation of the estimated coefficient. Further research could focus on analyzing exogenous sources of information in order to implement this type of strategy.

[25]Because we have one observation per child and we lack of reliable household identification, the option to account for robust estimations of the variance has been applied in order to control for heteroscedastic errors.

in Quetzaltenango and San Marcos, and in the data we observe that the largest number of treated children live in these departments (35.5% and 9.5%). Therefore, children living in these locations, were a bit more or less likely to suffer from underweight in 2015 and, thus, be treated by the volunteers in health. However, because children in the control group live in the same departments but have not been treated by the volunteers, this strategy enables us to account for the differences on the average of underweight children among departments.

In addition, the monitoring of children entering the nutritional recovery cycle normally takes place during the second half of the year, when the volunteers have completed certain modules of the training. Thus, we observe in the data[26] that more than half of the anthropometric measurements of treated children have been recovered between September and December and, consequently, higher shares of underweight children among the treated children are found during these months. Therefore, including binary variables for each month in which the children were measured during 2015, enables us to adjust for these differences.

Finally, the covariates included in the analysis are those shown in Table 4. These variables correspond to the information that the Foundation FUNDAP has recovered from the treated children and that we have been able to homogenize with the information available for the control group. We had observed in Table 4 that these characteristics are not fully balanced across treatment assignment. Particularly, in terms of the characteristics of the household in which the child lives, we had shown that the greatest deprivations in indicators such as access to improved sanitation and the quality of the housing materials, concern children receiving the treatment. Also, the share of girls in the treated sample is significantly higher than in the control group, which might be explained, for instance, by cultural characteristics.

Therefore, controlling for all these observable characteristics enables us to dissipate concerns on the selection bias and help us to rely on the CIA in order to assert that the comparison of average nutritional outcomes across treated and non-treated children has a causal interpretation.[27]

5 Main Results

In this section, we present main results from the two analysis that we perfom in this study.

5.1 Part 1: Analysis on the Full Sample of Treated Children

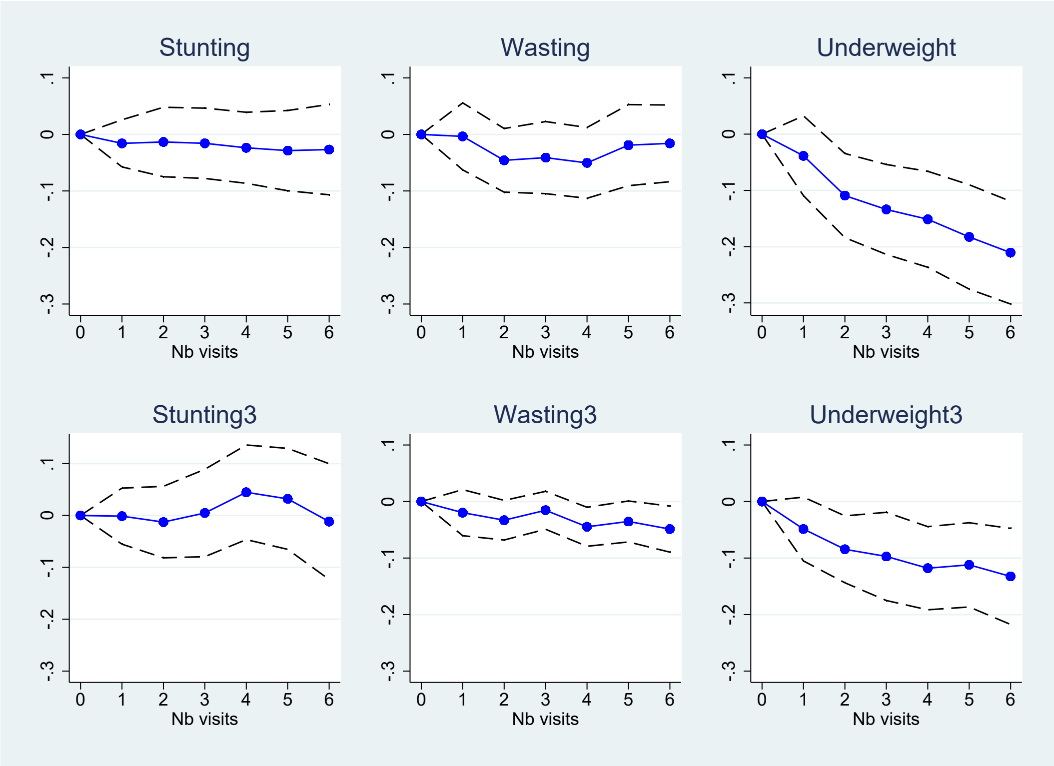
We proceed by estimating equation 1 and plot the estimated coefficients γ_j in figure 5. These results represent the probability of being stunted, wasted or underweight, also severely, at

[26] Tables available upon request.

[27] The vector of covariates is built from the available information that the Foundation FUNDAP uses in the implementation of nutritional recovery cycles program. Additionally, the binary variables at the department and at the month of the interview level contribute to capture those characteristics that could have an influence in the selection process and that are difficult to be measured. Thus, we assume that there is an absence of omitted variables bias that enable us to rely on the CIA for a causal interpretation of the estimated ATT coefficient (Angrist and Pischke, 2008).

each visit v during the nutritional recovery cycle (visits 1 to 6) relative to the first time the child was seen by a volunteer (visit 0).

Figure 5: Probability of being stunted, wasted and underweight by number of visits



Notes: each point represents the estimated coefficient γ_j from equation 1 on the population of children treated by the Foundation from 2015 to 2018. 95% CI included. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median).

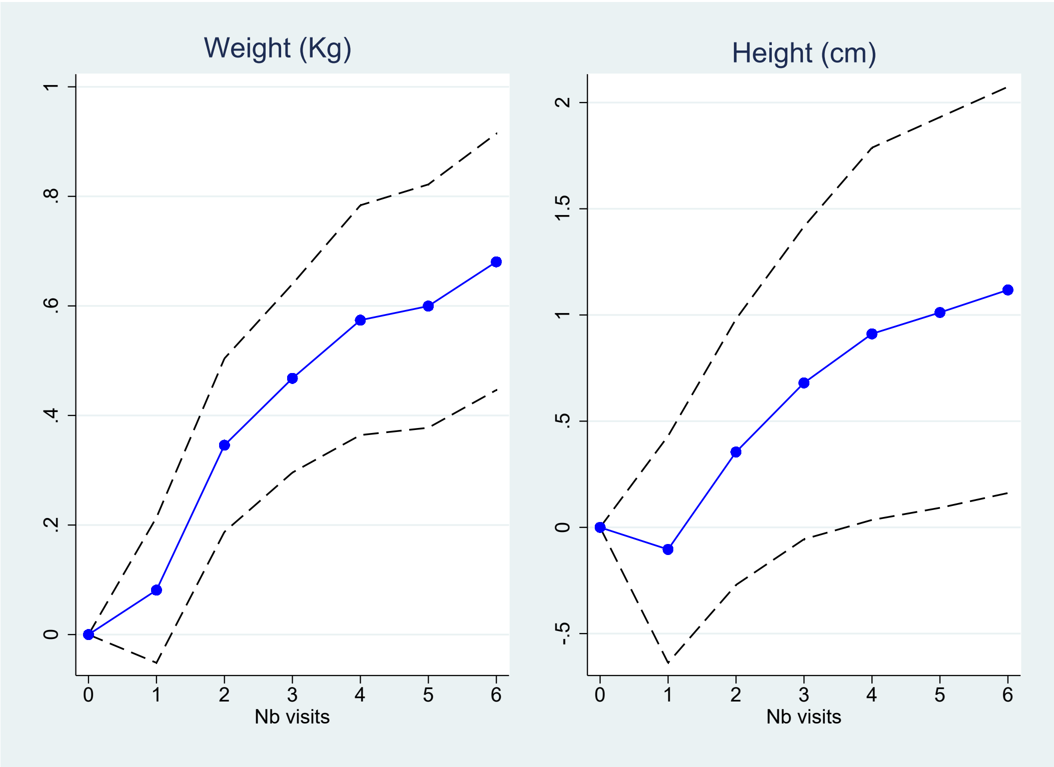
We observe that there seems to be no significant association between an additional visit by the volunteers and the probability of being stunted. Instead, we do find that the probability of being underweight, also severely, significantly starts to drop after the second visit and continues to decrease until the end of the recovery-cycle program. Results for the probability of being severely wasted are statistically significant with the fourth and the sixth visit. Table 16 in the Appendix provides point estimates for each visit. Results suggest that after receiving the sixth and last visit of the volunteers in health, the probability of a treated child of suffering from underweight is 21 p.p. lower with respect to the time in which s/he entered the program, on average. At the same time, the probability to be severely underweight is 13 p.p. lower[28].

It was surprising to us to find such a positive, strong, and significant reduction in the probability of being underweight, but not on the probability of being stunted and only some slight effect on the probability of being wasted. To deeper investigate this puzzling finding, we replicated the analysis on the single variables on weight, measured in kilograms, and height, measured in centimeters. Results are presented in figure 6 and in table 17 of the Appendix.

[28]These results are robust to a specification that includes a full set of individual fixed effects, omiting two year dummies and, thus assuming, that unobservable characteristics of those children measured in these two years are equal. Results can be provided upon demand.

We observe a positive and significant increase in both weight and height from the second and third visits respectively, and as the nutritional recovery cycle goes on, suggesting that the program has an effect on both dimensions. At the end of the cycle, children weigh almost 1 more kilogram, compared to the first time they were visited by the volunteers (visit 0) and gain 1.1 additional centimeters of height. Since low weight for age is influenced by both the size and weight of the child [29], it is possible to conclude that the combined weight gain and height allow the girl/boy to escape from a condition of low weight-for-age, but the increase in size alone is not enough to release it from the delay in its growth. This may be due to the fact that 6 months is not enough to observe a sufficiently large increase in the height so that the girl/boy could reach an appropriate size for her/his age, as might happen with weight, especially in children over 2 years.[30]

Figure 6: Weight and Height by Number of Visits



Notes: each point represents the estimated coefficient γ_j from equation 1 on the population of children treated by the Foundation from 2015 to 2018. 95% CI included. Weight refers to the weight of the child in Kilograms, Height to the height of the child in centimeters.

To continue with this analysis, we are now interested in measuring the average probability of being (severely) stunted, (severely) wasted or (severely) underweight when the child has completed a full recovery cycle (6 visits), compared to that when the cycle is not yet completed (visits 0 to 5). Table 5 provides results from the estimation of equation 2.

[29]See the definition of low weight for age as shown in Appendix A.

[30]In fact, the first 1,000 days from the beginning of the mother's pregnancy until the child's second birthday are those in which the child is growing faster and requires greater nutritional intake, adequate medical care and a good environment to achieve full growth and development potential (Cashin and Oot, 2018). During this period, if their nutritional intake is poor, children are more vulnerable to stunted growth and face irreversible consequences, such as an increased risk of illness and death, delayed mental development, poor school performance and reduced intellectual capacity (WHO, 2010). In other words, the loss of growth and development of a child during these first 1,000 days is difficult to recover after the age of two years (Cashin and Oot, 2018).

Table 5: Average effect of having completed one recovery cycle on the probability of being stunted, wasted or underweight

Variables	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
Complete Cycle	0.001	-0.027	-0.086***	-0.019	-0.035**	-0.051**
	(0.022)	(0.019)	(0.033)	(0.032)	(0.014)	(0.022)
Observations	945	945	945	945	945	945
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Covariates include child's age (in years) and its quadratic specification. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

Findings show that, once we control for the age of the child, time trends, and children time-invariant unobserved characteristics, the average probability of suffering from (severe) underweight is 8.6 (5.1) p.p. lower when a child completes a full recovery cycle. We also observe that treated children who have completed a full recovery cycle (visit 6), present lower probability of suffering low weight-for-height (3.5 p.p.), compared to when they participate to the program but they have not yet complete it (visits 0 to 5).

The replication of the analysis on the single indicators for weight and height presented in Table 6, confirms a significant increase in both weight and height after completing one recovery cycle.

Table 6: Average effect of having completed one recovery cycle on weight and height

Variables	(1) Weight	(2) Height
Complete Cycle	1.285***	1.737***
	(0.117)	(0.186)
Observations	945	945
Individual FE	Yes	Yes
Time FE	Yes	Yes
Covariates	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Covariates include child's age (in years) and its quadratic specification. Weight refers to the weight of the child in Kilograms, height to the height of the child in centimeters. Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

5.2 Part 2: Analysis on the Sub-Sample of Children in the Treated and Control Groups

In this section, we present the main results obtained from the estimation of equation 6. Table 7 presents main results of the average treatment effect on the treated children of the program Volunteers in Health and the Nutritional Recovery Cycles. Each column shows estimation of the regression of each undernutrition outcome on dummy variables at the department level as well as for each month of interview/measurement and the covariates listed in Table 4. We observe that the underweight (or low weight-for age) coefficient that appears in column 3, is negative and significant at the 10% confidence level. The interpretation that we extract from this result is that, on average, the probability that a child between 10 and 59 months suffered from low weight for her/his age in 2015, significantly decreased by 23.6 p.p. when she/he was monitored by the volunteers in health and thus received the treatment.

Table 7: Main results of the program Volunteers in Health and the Nutritional Recovery Cycles - ATT effect

Variables	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
ATT	0.262*	0.024	-0.236*	0.176	-0.000	0.022
	(0.158)	(0.038)	(0.143)	(0.376)	(0.001)	(0.062)
Observations	1,686	1,686	1,686	1,686	1,686	1,686
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors in parentheses. Covariates include ownership of animals in the household, improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

According to the Foundation FUNDAP, finding a significant negative result for the weight-for-age indicator and not for the height-for-age or the weight-for-height, might be due to the fact that most of the children that enter in the nutritional recovery cycle already present low height for their age and the intake of micronutritients helps children gain weight rather than height while the recovery lasts. This might also explain the positive statistically significant coefficient that we find for stunting. In this sense, is not that the program increases the probability of treated children to be stunted. Children might gain height during the recovery cycle but this gain might not be enough, so that the children would still present low height for her/his age once the cycle ends. This is consistent to what we find in table 4: 80.3% of the treated children are stunted, whereas 35% are underweight. Looking closer at the data, 93.8% of those who are underweight are also stunted, which is consistent with the observations from the Foundation FUNDAP.

Following Cashin and Oot (2018), the first 1,000 days from the beginning of the pregnancy of the mother to the second birthday of the child are those when the child is growing more rapidly and requires higher nutritional intake, adequate health care, and a good environment to reach her/his full growth and development potential. During this period, if their nutritional intake is deficient, children are most vulnerable to be stunted and face irreversible consequences such as increased risk of illness and death, delayed mental development, poor school performance and reduced intellectual capacity (WHO, 2010). In other words, the loss of growth and development of a child during these first 1,000 days are difficult to recover after the age of two (Cashin and Oot, 2018). Therefore, since low height-for-age is more difficult to reverse, the results shown in Table 8 seem to translate a more likely gain of weight, rather than height, during the period the child is in the nutritional recovery cycle. One could think that children under the age of two improving their weight-for-age over time (and not just during the treatment period), might also be able to improve their height. For this to be analyzed, the Foundation FUNDAP would need to recover data from under two years old treated children after some period of time.

Table 8: Baseline results of the program Volunteers in Health and the Nutritional Recovery Cycles - ATT effect

Variables	(1) Underweight	(2) Underweight	(3) Underweight
ATT	0.190***	-0.091	-0.145
	(0.042)	(0.087)	(0.135)
Observations	1,686	1,686	1,686
Time dummies	No	Yes	Yes
Department dummies	No	No	Yes
Covariates	No	No	No

Notes: robust standard errors in parentheses. Covariates include ownership of animals in the household, improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Underweight makes reference to low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

In Table 8, it is relevant to note that a naive comparison of outcomes as it is done in column 1, just informs us that children monitored by the volunteers in 2015 were significantly less healthy, on average. More precisely, the share of treated children presenting low weight for their age was 19 p.p higher than the share of non-treated children, which is what we observe in the descriptives of Table 4. Proceeding with this naive comparison would make us conclude that the program of the Foundation FUNDAP made children sicker. However, when we start controlling for the month the child was interviewed (column 2 of table 8) and also for time-invariant characteristics at the department level (column 3 of table 8), we observe that the coefficient of the treatment variable becomes negative, although still not significant.

In Table 9 we go step by step adding family and individual characteristics that play a role in the selection of the treated sample and that might hint the average effect of the program on the nutritional health of children. We have seen in the previous section that it is relevant to control for these observable characteristics in order to be able to compare average nutritional outcomes across treated and non-treated children and give the average treatment

Table 9: Baseline results of the program Volunteers in Health and the Nutritional Recovery Cycles - ATT effect

Variables	(1) UW	(2) UW	(3) UW	(4) UW	(5) UW	(6) UW	(7) UW
ATT	-0.237*	-0.253*	-0.251*	-0.235*	-0.235*	-0.248*	-0.236*
	(0.137)	(0.139)	(0.139)	(0.140)	(0.141)	(0.140)	(0.143)
Good housing materials	-0.101***	-0.092***	-0.091***	-0.094***	-0.094***	-0.094***	-0.094***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Improved sanitation		-0.069**	-0.069**	-0.066**	-0.066**	-0.067**	-0.066**
		(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Ownership animals			0.007	0.012	0.012	0.013	0.013
			(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Drinking water				-0.041*	-0.042**	-0.042*	-0.041*
				(0.021)	(0.021)	(0.021)	(0.021)
Ever vaccinated					0.009	0.009	0.007
					(0.030)	(0.030)	(0.030)
Gender: girl						-0.028	-0.028
						(0.018)	(0.018)
Age in months							0.006*
							(0.003)
Age in months (squared)							-0.000**
							(0.000)
Observations	1,686	1,686	1,686	1,686	1,686	1,686	1,686
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors in parentheses. UW makes reference to underweight – low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

effect of the program on the treated children (ATT) a causal interpretation. Therefore, we proceed to include them and show that β, the coefficient of the ATT, becomes statistically significant at the 10% confidence level when we start controlling for these observable characteristics, underlining their relevance in the estimated equation. Moreover, the coefficient is quite stable across specifications.

We further observe that the coefficients of some variables, such as improved sanitation, good housing materials and access to drinking water, are statistically significant and negatively related with the probability of being underweight. Additionally, we know from Table 4, that treated children are more significantly deprived in the first two, whereas children in the control group have less significant access to drinking water. By including these variables in the regression, we are able to control for those characteristics that might help explain the selection of the child into the treatment and, thus, interpret the ATT coefficient as the effectiveness of the program Volunteers in Health and the Nutritional Recovery Cycles in the reduction of the underweight prevalence among children between 10 and 59 months of age in West Guatemala in 2015.

6 Robustness Checks

In this section, we intend to further check that baseline results are indeed stable, in order to be able to draw conclusions from them.

6.1 Part 1: Analysis on the Full Sample of Treated Children

To test for the robustness of results found in tables 5 6, we re-estimate equation 2 on the extended sample of children who completed more than one recovery cycle (5 additional children). Results, shown in tables 10 and 11, confirm previous findings: participating into one or two nutritional recovery cycles is associated with lower probability of suffering underweight (9.6 p.p), severe underweight (4.6 p.p.) and wasting (2.8 p.p.) and increases weight by 1.2 Kg and height by 1.8 centimeters, on average.

Table 10: Average effect of having completed one or two recovery cycles on the probability of being stunted, wasted or underweight

Variables	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
Complete Cycle	0.015	-0.010	-0.096***	-0.017	-0.028**	-0.046*
	(0.0251)	(0.0225)	(0.0325)	(0.0298)	(0.0142)	(0.0251)
Observations	1,033	1,033	1,033	1,033	1,033	1,033
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Covariates include child's age (in years) and its quadratic specification. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Average effect of having completed one or two recovery cycles on weight and height

Variables	(1) Weight	(2) Height
Complete Cycle	1.282***	1.774***
	(0.119)	(0.174)
Observations	1,033	1,033
Individual FE	Yes	Yes
Time FE	Yes	Yes
Covariates	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Covariates include child's age (in years) and its quadratic specification. Weight refers to the weight of the child in Kilograms, height to the height of the child in centimeters. Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

6.2 Part 2: Analysis on the Sub-Sample of Children in the Treated and Control Groups

To test for the stability of results found in table 7 and table 9, we proceed by perfoming two robustness checks: the first consists on a falsification test and the second one controls for the lean (or dry) season in Guatemala.[31]

In order to proceed with the first one, we rely only on data from the National Maternal and Children's Health Survey, but for the year 1998/1999. As in the main analysis, we defined treated children as those living in the municipalities in which the volunteers in health worked during 2015 and control children as those living in the same departments but in municipalities where the volunteers in health did not work in 2015.[32] The main purpose of this robustness check is to assess whether, before the implementation of the program and conditional on observable characteristics, there were significant differences in underweight outcomes between children living in municipalities that will become treated and those that will not. Finding negative statistically significant coefficients would mean that the decrease in the probability of children suffering from underweight in the treated municipalities is not due to the program Volunteers in Health and the Nutritional Recovery Cycles, but rather to something else.

Table 12: Robsutness checks: 1998/1999 analysis

Variables	(1) Underweight	(2) Underweight	(3) Underweight
ATT	0.041	0.066	0.092
	(0.059)	(0.070)	(0.071)
Observations	294	294	194
Time dummies	No	Yes	Yes
Department dummies	No	Yes	Yes
Covariates	No	No	Yes

Notes: robust standard errors in parentheses. Covariates include improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Underweight makes reference to low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

Results are presented in Table 12. Column 3 reproduce baseline estimations of equation 6. We observe that coefficients are not statistically significant in any of the specifications.

[31]We also perfom a propensity score matching, using the covariates listed in table 4, the department identification and the month when children are interviewed/measured. However, the matching did not succeed in creating a sufficient sample to calculate the average treatment effect due to low matches in the month of the interview. We acknowledge this limitation and we claim that, so far, this is the best that we are able to do. Further research would focus on retrieving data on a better control group in order to be able to improve the matching and the estimation of the effectiveness of the program.

[32]The National Maternal and Children's Health Survey of 1998/1999 does not have GPS data and municipalities are only coded with a number, without any label. This does not enable us to properly identify the municipalities and for this matter we use available information in https://www.gifex.com/. This website provides large mapping information, among which number and name identification of the municipalities of each department. We acknowledge this might not be the most accurate procedure, but so far it is the best we have found.

Therefore, we are able to assert that our baseline results presented in column 3 of Table 7 (and in column 7 of Table 9) are specific to the program Volunteers in Health and the implementation of the Nutritional Recovery Cycles by the Foundation FUNDAP.

The last robustness check that we try is to control for the lean season. This corresponds to those months of the year characterized by a drier weather that particularly affects tropical countries. During these months, the harvest from the first sowing season is almost concluded and the dry weather not only delays and reduce plantings but also affects crop development and yields negatively (FAO, 2015). In Guatemala, the most affected are the dry corridor and the south coast, which corresponds to the Central-North and West departments of the country. Because employment is also low during this season, subsistence households are more vulnerable to face food insecurity and are in need of assistance (FAO, 2015).

Following the FAO (2015) report, the lean season in Guatemala takes place between April and July, included. Therefore, we proceed to create binary variables for this months of the year and we introduce them in equation 6 and re-estimate previous regressions on underweight. Column 3 of Table 13 shows that the baseline results found in the previous section are robust when controlling for the months of the year when children are potentially more vulnerable to be underweight due to the restrictive weather conditions.

Table 13: Robustness checks: lean season

Variables	(1) Underweight	(2) Underweight	(3) Underweight
ATT	0.215***	-0.145	-0.236*
	(0.045)	(0.135)	(0.143)
Observations	1,686	1,686	1,686
Time dummies	No	Yes	Yes
Department dummies	No	Yes	Yes
Covariates	No	No	Yes

Notes: robust standard errors in parentheses. Covariates include ownership of animals in the household, improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Underweight makes reference to low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

All in all, despite not having accurate data on children who did not enter the nutritional recovery cycle but who, nonetheless, were measured by the volunteers, the analysis of the present study is able to show that the program of Volunteers in Health and the service on Nutritional Recovery Cycles had a significant impact on the improvement of children's nutritional status in 2015 in Western Guatemala.

7 Conclusions

Child undernutrition is still a major challenge, both in developed and developing countries. Effective policies are hard to define, given the heterogeneity of malnutrition forms and social conditions of targeted children. In this paper, we provide evidence of the effectiveness of the training project for Volunteers in Health and the Nutritional Recovery Cycles, implemented by the Foundation FUNDAP, aimed at alleviating child undernutrition in a particularly disadvantaged socioeconomic context in Western Guatemala. The program Volunteers in Health operates at the local level and aims at providing specific knowledge within communities in order to raise awareness on child health and nutritional habits. The inhabitants of the community, mostly women, who participate in the program are trained to become the first source of knowledge and help for mothers in a region where ignorance on fertility and newborn childcare is still high. The specific service they implement, the Nutritional Recovery Cycles, consist of monthly visits to children during 6 months, in which the volunteers measure the growth of the children, provide them with food supplements and transmit the necessary information to the mothers about the nutritional and health care of their children.

For the first time, the effectiveness of the project has been fully and scientifically evaluated through two types of analysis. Throught them, we find that, as the nutritional recovery cycle goes on, children nutritional status improves. Starting from the second visits, the probability for children of being underweight starts to decrease as compared to the timing in which they entered the program. After having completed one recovery cycle, the probability for children to be underweight is 21 p.p. lower. On average, controlling for age, time trends and children time-invariant unobserved heterogeneity, completing a nutritional recovery cycle is associated with 8.6 p.p. lower probability to be underweight. Despite finding such a positive and strong reduction in the probability of having low weight-for-age, no impact has been detected in the probability of being stunted. The results of the analysis performed using the individual indicators of weight (in kilos) and height (in centimeters), show a significant increase in the child's weight from the second visit and with each additional visit, until reaching around 0.7 additional kilograms by the end of the nutritional recovery cycle, compared to the weight the child had the first time s/he was measured, on average. The height also increases significantly from the third visit, to reach around 1.1 centimeters more with the last visit. However, the increase in height is not enough to significantly reduce the likelihood of the child facing a condition of low height for her/his age, perhaps because the six month that the cycle lasts is a relatively short period of time, mainly for children over two years of age.

We provide further evidence by comparing standard health outcomes between children who lived in municipalities where the volunteers worked and those of children living in close municipalities where the volunteers did not reach yet in 2015. Controlling for a large set of observable characteristics, which help mitigate concerns of selection bias, we are able to find that the program was significantly effective in improving nutritional health of treated children. More precisely, we find that, on average, the probability that a child between 10 and 59 months suffered from low weight for her/his age in 2015 decreased significantly by 23.6 p.p. when she/he was monitored by the health volunteers and her/his mother received the adequate knowledge regarding the health of her child.

These results are robust to different tests. In particular, expanding the sample including the most sick treated children did not affect the main findings on the average effect of the nutritional recovery cycle program. Results from the falsification tests that we carry out using data prior to the beginning of the implementation of the program in Western Guatemala (National Maternal and Children's Health Survey of 1998/99) provide further evidence of the stability and robustness of our findings, as when controlling for the dry season in Guatemala.

The main message that comes from this evaluation is that the implementation of the training project for Volunteers in Health implemented by the Foundation FUNDAP and the work carried out by the volunteers through the Nutritional Recovery Cycles, is particularly effective in reducing child undernutrition and improve the nutritional health of girls and boys in Western Guatemala. The study highlights how training women, a strong female empowerment factor, represents a powerful instrument that has beneficial effects at the individual, family and community levels.

These results show that the design of health programs that operate at the local level and involve the participation of all members of the communities, such as those developed by the Foundation FUNDAP, can be particularly effective in reducing child undernutrition.

Further research would focus on improving the data for a comparable group of children in order to be able to improve matching analysis and be able to draw a more robust result on the effectiveness of the program Volunteers in Health and the service the volunteers provide, the Nutritional Recovery Cycles.

References

Angrist, J. D. and Pischke, J.-S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

Cashin, K. and Oot, L. (2018). Guide to anthropometry. a practical tool for program planners, managers, and implementers. Technical report, Washington, DC: Food and Nutrition Technical Assistance III Project (FANTA)/FHI 360. Retrieved the 04/10/2019 from https://www.fantaproject.org/sites/default/files/resources/FANTA-Anthropometry-Guide-May2018.pdf.

Cecchini, S. and Soares, F. V. (2015). Las transferencias monetarias condicionadas y la salud en américa latina. *MEDICC Review*, 17(S1):8–9.

Chou, S.-Y., Liu, J.-T., Grossman, M., and Joyce, T. (2010). Parental education and child health: evidence from a natural experiment in taiwan. *American Economic Journal: Applied Economics*, 2(1):33–61.

De-Onis, M. and Blossner, M. (1997). Who global database on child growth and malnutrition. Technical report, World Health Organization.

FAO (2015). Giews update. central america drought update. Technical report, Food and Agriculture Organization of the United Nations. Retrieved the 04/10/2019 from http://www.fao.org/3/a-I4926E.pdf.

FAO (2018). The state of food security and nutrition in the world. building climate resilience for food security and nutrition. Technical report, Food and Agriculture Organization of the United Nations. Retrieved the 04/10/2019 from http://www.fao.org/3/i9553en/i9553en.pdf.

Fitzsimons, E., Malde, B., Mesnard, A., and Vera-Hernandez, M. (2016). Nutrition, information and household behavior: Experimental evidence from malawi. *Journal of Development Economics*, 122:113–126.

Gertler, P. (2004). Do conditional cash transfers improve child health? evidence from progresa's control randomized experiment. *American economic review*, 94(2):336–341.

Glewwe, P. (1999). Why does mother's schooling raise child health in developing countries? evidence from morocco. *Journal of human resources*, pages 124–159.

Imai, K. S., Annim, S. K., Kulkarni, V. S., and Gaiha, R. (2014). Women's empowerment and prevalence of stunted and underweight children in rural india. *World Development*, 62:88–105.

Maluccio, J. A., Hoddinott, J., Behrman, J. R., Martorell, R., Quisumbing, A. R., and Stein, A. D. (2009). The impact of improving nutrition during early childhood on education among guatemalan adults. *The Economic Journal*, 119(537):734–763.

Marini, A. and Gragnolati, M. (2003). Malnutrition and poverty in guatemala technical paper no. 6. Technical report, World Bank. Retrieved o 06/10/09/2019 from http://web.worldbank.org/archive/website00955A/WEB/PDF/GUAPA_NU.PDF.

MSPAS and INE and Segeplán (2017). Informe final. vi encuesta nacional de salud materno infantil 2014-2015. Technical report, Ministerio de Salud Pública y Asistencia Social (MSPAS), Instituto Nacional de Estadística (INE) and Secretaría de Planificación y Programación de la Presidencia (Segeplán). Retrieved the 04/10/2019 from https://dhsprogram.com/pubs/pdf/FR318/FR318.pdf.

Paes-Sousa, R. and Santos, L. M. P. (2009). Measuring the impact of bolsa familia program based on data from health and nutrition days (brazil). Technical report, Santiago: FAO. Retrieved the 04/10/2019 from http://www.oda-alc.org/documentos/1323953814.pdf.

Rojas, A. G., Villegas, W. M. A., Sierra, E. A. A., Ramirez, A. C., and Marquez, A. (2007). Evaluación del programa familias en acción. piloto centros urbanos. Technical report, Departamento Nacional de Planeación. Dirección de Evaluación de Políticas Públicas. Retrieved the 04/10/2019 from http://biblioteca.usbbog.edu.co:8080/Biblioteca/BDigital/40680.pdf.

UNICEF (2013). Annual report 2013 - guatemala. Technical report, United Nations International Children's Emergency Fund. Retrieved the 04/10/2019 from https://www.unicef.org/about/annualreport/files/Guatemala_COAR_2013.pdf.

UNICEF and WHO and World Bank (2018). Levels and trends in child malnutrition: Key findings of the 2018 edition of the joint child malnutrition estimates. Technical report, United Nations Children's Fund, World Bank Group and World Health Organization. Retrieved the 04/10/2019 from https://reliefweb.int/sites/reliefweb.int/files/resources/JME-2018-brochure-web-1.pdf.

United Nations (2009). Urban indicator guidelines. monitoring the habitat agenda and the millenium development goals-slums target. Technical report, United Nations Human Settlement Programme.

WHO (2010). Nutrition landscape information system (nlis) country profile indicators: interpretation guide. Technical report, World Health Organization. Retrieved the 04/10/2019 from https://apps.who.int/iris/bitstream/handle/10665/44397/9789241599955_eng.pdf.

A Description of Variables

A.1 Variables on Undernutrition

Malnutrition may appear in the form of undernutrition or overweight (De-Onis and Blossner, 1997). This study focuses on undernutrition and its major types that are:

- Acute malnutrition (wasting/low weight-for-height): wasting indicates, in most cases, a recent and serious risk of weight loss, that is most frequently associated with acute hunger and/or serious disease. Nonetheless, wasting can also be the result of chronic unfavorable conditions.
- Chronic malnutrition (stunting/low height-for-age): low height-for-age reflects a process of inability to reach a linear growth potential as a result of suboptimal health and/or nutritional conditions. At the population base, high levels of stunting are associated with bad socioeconomic conditions and a higher risk of frequent and sooner exposure to adverse conditions, like diseases and/or inadequate feed practices.
- Underweight (combine stunting and wasting/ low weight-for-age): low weight-for-age reflects low body mass in relation to the chronologic age of the child, and it is influenced by both the height of the child (height-for-age) and his/her weight (weight-for-height). This indicator fails to distinguish between short children of adequate body weight and tall, thin children. Nonetheless, in the absence of significant wasting within a community, similar information is provided by weight-for-age and height-for-age, in that both reflect the long-term health and nutritional experience of the individual or population.

The way to identify whether a child from birth to five years of age faces any of the three types of malnutrition is through her/his anthropometric measurement (weight-for-age, height-for-age and weight-for-height). According to these measures, a z-score is calculated, which is used to compare the results from the child to those from the accepted international reference population's median value calculated by the World Health Organisation (WHO) and which is sex-specific. If the z-score is below minus two standard deviations from the median of the reference population, the child can be either classified with low weight-for-height (wasted), low height-for-age (stunted) and low weight-for-age (underweight). If the z-score is below minus three standard deviations from the median of the reference population, the child is classified as severely wasted, stunted or underweight.

A.2 Variables on Household's Characteristics

These variables have been coded following the Millenium Development Goals Guidelines (United Nations, 2009) as follows:

- Improved sanitation: the household has access to improved sanitation facilities that flush to a piped sewer system or to a septic tank or has latrine or ventilated improved pit latrine.

- Access to drinking water: the household has access to water piped into dwelling, piped to yard/plot, has public tap/standpipe or other piped.
- Ownership of animals: the household owns livestock herds or farm animals.
- Good quality of housing materials: the household has walls of good quality, such as cement, stone with lime/cement, bricks, cement lock or covered adobe

B Treated Departments

Table 14 summarizes the main characteristics of the departments where the Foundation FUNDAP is implementing the program Volunteers in Health. Statistics are derived from the 2014/2015 National Maternal and Children's Health Survey used in the empirical analysis.

Against a country average of 41.5%, most of treated departments have a larger share of indigenous population, that reaches more than 90% in Quiché, Sololá, and Totonicapán. The share of individuals living in rural areas is high, especially in the departments of Huehuetenango, Quiché and San Marcos.

Only three departments (Retalhuleu, San Marcos and Suchitepéquez) show a share of individuals with no education below the country's average of 28.0%. In the departments of Huehuetenango and Quiché almost half of the individuals sampled have zero level of education.

As regards health coverage, the most penalized departments are those of Huehuetenango, Quiché, San Marcos, and Totonicapán, where less than 50% of respondents declare to have an easy access to health care facilities.

Table 14: Treated departments: main characteristics

	% Indigenous	% Rural	% Not Educated	% Health coverage	Observations
Huehuetenango	66.9	79.9	47.4	39.3	2,815
Quetzaltenango	52.5	51.5	28.6	57.4	2,428
Quiché	93.6	81.2	49.7	46.4	3,174
Retalhuleu	19.5	67.4	19.2	52.1	2,190
San Marcos	34.9	81.8	24.2	44.1	2,713
Sololá	95.4	55.1	38.0	61.0	2.503
Suchitepéquez	35.6	59.3	23.3	56.9	2,347
Totonicapán	95.0	68.1	36.1	42.7	2,657
Country	41.5	63.4	28.0	55.5	55,398

Notes: statistics produced from the raw data available in the last National Maternal and Children's Health Survey of 2014/2015. Health coverage is measured as accessibility to health care facilities.

C Review of Some Health Programs' Evaluation in Latin America

Table 15 summarizes some key aspects of the impact evaluation of education and health programs on children growth indicators in Latin America.

Table 15: Review of some health programs' evaluation in Latin America

Country	Reference	Program	Analysis	Main results	Channels
Brazil	Paes-Sousa and Santos (2009)	Bolsa de Familia Program (BFP): cash transfers conditional on households engaging in improving behavior on health and education since 2004	Impact evaluation of the BFP on children antropometric indicators using data collected during vaccination campaigns btw2005 and 2006 in 4 regions	Probability of suffering from stunting or underweight decreases by 26% when child btw 0 and 5 years old receives the BFP	Change in dietary patterns, budget improvement to purchase more food, aspirations to eat more healthy. Not specification of the impact of each aspect
Mexico	Gertler (2004)	Pogresa: conditional cash transfers program to engage households in improving behavior on health, nutrition and education, since 1997	Impact evaluation of Progresa on children morbidity, height and anemia using data from large socioeconomic survey on experimental villages	Treated children are 25.5% less likely to be ill and to be anemic and they are 0.96 cm taller	Growth monitoring, pre/postnatal care, parental education on nutrition, health and hygiene, and nutritional supplements. Does not indicate which aspects matter
Colombia	Rojas et al. (2007)	Familias en Acción: cash transfers to poorest families to improve nutritional health and education of children, conditional on growth monitoring and school attendance, since 1990	difference-in-difference using semi-experimental data for two cities treated eligible non-treated, to evaluate impact on health and education indicators	Treated children are 0.45cm taller than control children and the probability of suffering acute diarrheal disease decreases by 10 p.p.	Growth monitoring in health facilities Not clearly specified

D Additional Results

Table 16: Probability of being stunted, wasted and underweight by number of visits

	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
1 visit	-0.0201	-0.00369	-0.0398	-0.0111	-0.0204	-0.0423
	(0.0211)	(0.0309)	(0.0370)	(0.0267)	(0.0213)	(0.0284)
2 visits	-0.0173	-0.0474	-0.0971**	-0.0233	-0.0342*	-0.0794***
	(0.0315)	(0.0293)	(0.0378)	(0.0346)	(0.0183)	(0.0300)
3 visits	-0.0190	-0.0434	-0.123***	0.00303	-0.0164	-0.0927**
	(0.0318)	(0.0332)	(0.0407)	(0.0429)	(0.0175)	(0.0400)
4 visits	-0.0294	-0.0531	-0.146***	0.0421	-0.0464**	-0.122***
	(0.0317)	(0.0327)	(0.0439)	(0.0468)	(0.0181)	(0.0380)
5 visits	-0.0318	-0.0206	-0.172***	0.0345	-0.0367*	-0.108***
	(0.0365)	(0.0374)	(0.0477)	(0.0490)	(0.0190)	(0.0382)
6 visits	-0.0297	-0.0173	-0.209***	-0.0110	-0.0507**	-0.129***
	(0.0414)	(0.0354)	(0.0475)	(0.0568)	(0.0214)	(0.0437)
Observations	884	884	884	884	884	844
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Covariates include dummies for child's age (in years). Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

Table 17: Weight and height by number of visits

	(1) Weight	(2) Height
1 visit	0.0811	-0.104
	(0.0671)	(0.270)
2 visits	0.346***	0.355
	(0.0800)	(0.316)
3 visits	0.468***	0.680*
	(0.0870)	(0.372)
4 visits	0.574***	0.911**
	(0.106)	(0.443)
5 visits	0.600***	1.012**
	(0.112)	(0.465)
6 visits	0.681***	1.118**
	(0.118)	(0.483)
Observations	884	884
Covariates	Yes	Yes
Time dummies	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Weight is measured in Kilograms, height in centimeters. Covariates include dummies for child's age (in years). Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1