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# Intergenerational Social Mobility Based on the Investments in Human Capital

## Evidence of the Long-Term Results of PROSPERA in Health

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## Abstract

Mexico's conditional cash transfer program, PROSPERA, has demonstrated short- and medium-term positive effects on health and education, including: increased children's height; decreased risky behaviors among adolescents, including the postponement of parenthood; and increased years of schooling. This paper explores whether these effects lasted in the long-term and translated into positive changes in outcomes across generations. This study uses the most recent PROSPERA Evaluation Survey (ENCEL 2017) and combines it with previous waves and with the 1997 Socioeconomic Characteristics Survey (ENCASEH). Using intergenerational mobility analysis and quasi-experimental methods, this study finds strong evidence of positive absolute intergenerational mobility in height and years of schooling. The findings show that, on average, male offspring are 2.8 centimeters taller and have 5.3 more years of schooling than their providers (usually their parents), while female offspring are 4.1 centimeters taller and have 5.7 more years of schooling than their providers. These intergenerational gains are relevant not only because they reflect improvements in human capital, but also because these improvements have a positive return to investment. The study finds that a 1 percent increase in height is associated with a 10.7 and 8.8 percent increases in hourly wages for men and women, respectively. The analysis finds that a one-year increase in schooling is associated with 3.4 and 4.8 percent increases in hourly wages for men and women, respectively. These results show that PROSPERA has been successful in helping children and youth build human capital through better health and education, which has led to positive returns in the labor market.



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# Intergenerational Social Mobility Based on the Investments in Human Capital: Evidence of the Long-Term Results of PROSPERA in Health[1]

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## I. Introduction

In 1997, Mexico adopted a novel approach to social policy with the creation of the Education, Health and Nutrition Program (PROGRESA, by its Spanish acronym), a public conditional cash transfer program that sought to reduce the intergenerational transmission of poverty through incentivizing the development of human capital of the children in beneficiary households (Levy and Rodriguez, 2005).

In the last two decades, the program was transformed in response to political changes and the results of multiple evaluations. In 2001, PROGRESA changed its name to the Human Development Program (*Oportunidades*). This transition occurred as the program expanded in to urban areas and extended its educational scholarships through high school ($10^{th}$ to $12^{th}$ grades). In 2014, the program was renamed the Social Inclusion Program (PROSPERA), and was expanded to promote more *inclusive* development (in multiple spheres: job market, small business, social, and financial).

The program's design was based on the approach proposed by Amartya Sen, who argued that people need health, nutrition and education as the fundamentals to be able to develop their individual *capabilities* (Levy, 1991; Sen, 1983). Thus, from the human capital perspective, investment in health contributes to intergenerational social mobility,[2] both because healthier children become adults with greater cognitive and physical capabilities and because healthy children and adults can spend more time (and more effective time) improving their education and working. Furthermore, investment in education promotes mobility by facilitating access to better jobs.

The human capital model, originally proposed by Grossman, describes the synergy between health and education. Health is desirable in its own right because it increases both the quality and length of life (and of economically productive life), and health also enables the development of other *capabilities* (particularly education). As a result, resources destined to improve health improve welfare both directly and indirectly (Grossman, 1972; Bloom and Canning, 2003).

It has been proposed that the relationship between health and education is synergistic. Hence, the development of cognitive abilities as well as associated educational achievement is greater among healthy individuals. Healthy individuals also demonstrate better job performance. Moreover, the increase in knowledge and skills gained from education contributes to better health. (Grossman, 1999). Beyond its intrinsic value, the model proposed by Grossman (1972) postulates that health capital,[3] together with educational capital, are central elements of human capital. That is, they are fundamental elements of the set of abilities, knowledge and attributes, including creativity, that favor the creation of economic value.

This general approach that considers health and education to be core elements that generate human capital, is the conceptual foundation of PROSPERA (previously known as PROGRESA and *Oportunidades*). PROSPERA's design focuses on generating sufficient education, health and nutrition among the children in a household to enable the full development of their capacities (Behrman and Deolalikar, 1988; Brown and Pollitt, 1996; Grosh, 1994; Levy, 1991; Lipton and Ravallion, 1995; Sen, 1983; Strauss and Thomas, 1995).

[2] Briefly, intergenerational social mobility it is understood to be the difference in the socioeconomic status between parents (or persons responsible for providing for the household) and their direct descendants when these persons reach adulthood.
[3] Health capital refers to the contribution that healthy time and health *per se* generate to human capital.

PROSPERA, like all transfer programs, includes several specific mechanisms to influence the development of human capital: health promotion (disease prevention) efforts, increasing access to health care, improving school attendance, and increasing household resources (Cecchini and Soares, 2015; Gaarder, Glassman and Todd, 2010).

The intervention's expected outcome is to disrupt the cycle of poverty that persists across generations and that manifests itself along various social and economic dimensions. It is expected that by creating better conditions during children's growth and development, they will accumulate more human capital (i.e. better physical condition, greater cognitive abilities, and greater abilities acquired through formal education). From a labor and economic perspective, it is expected that improved health, educational, and nutritional capital will lead to improved outcomes in the labor market with consequent higher incomes.

The program's theory of change makes the following important assumptions: 1) that the program's target population demands and uses the health, nutrition, and education services and products that contribute to human capital formation; ii) that the services and products offered have an adequate quality level (Gaarder, Glassman and Todd, 2010); and iii) that a set of pre-conditions are met so that the accumulation of human capital can be used to generate welfare for the beneficiary families. For example, the benefits of improved human capital in the labor market requires that the economy has the capacity to offer quality jobs to people with greater human capital.

Based on the short- and mid-term evaluation findings that demonstrated PROSPERA's effectiveness in achieving better health and educational outcomes, this paper aims to estimate the program's intergenerational health outcomes after 20 years of intervention in rural areas. Specifically, this study seeks to answer the following questions regarding PROSPERA's outcomes in the population living in rural villages that received the program between 1998 and 2000: i) How much *less* do parental height and education predict the height and education of their children because of PROSPERA? And, what is the absolute difference in intergenerational mobility attributable to the program? ii) Has PROSPERA improved health and education indicators among the population that received the intervention during critical moments for growth and development? and iii) What are the effects of changes in health and education on income?

To answer these questions, we estimate the population's intergenerational mobility in terms of magnitude of change in health and education. We use measures of maximum attained height and years of schooling, analyze the contribution of PROSPERA on mobility, and, finally, estimate the labor income returns to changes in health and education.

The paper proceeds as follows: Section II presents the health context in Mexico for the period 1997 to 2017. Section III presents a review of the program's theory of change and its contribution to intergenerational social mobility in human capital, as well as a review of the literature that documents the initial phases of the results chain of PROSPERA. Section IV discusses the use of height as an indicator of health capital and reviews the approach used in this study to estimate changes in mobility. Section V presents the data used. Section VI outlines the methodological approach. Section VII presents the results of the analyses and, lastly, final remarks on the results and conclusions are presented in section VIII.

## II. Context: Population health in Mexico between 1997 and 2017.

The last two decades in Mexico have been marked by large changes in population health as a consequence of extensive policy change, economic development, and demographic and epidemiological transitions. These changes have not only affected the PROSPERA target population, but the population of Mexico at large.

According to the National Population Council (CONAPO), in 1997 Mexico had a population of 97.2 million where 50.5% were women. In 1997, the average life expectancy at birth was 72.7 years (69.8 for men and 75.6 for women). The infant mortality rate was 23.8 per 1,000 live births (26.2 in boys and 21.3 in girls), and the crude mortality rate was 5.1 per 1,000 inhabitants. The fertility rate was 2.8 children per woman.

Twenty years later, in 2017, we see important changes in many of these indicators: 51.2% of the 123.5 million inhabitants were women, life expectancy at birth was 75.3 years, an increase in 2.7 years from 1997: 3.1 years among men and 2.2 years among women. In twenty years, the infant mortality rate dropped to 11.4 per 1,000 live births, a reduction of 52.2% for both boys and girls. Furthermore, the crude mortality rate increased by 12.5% to 5.8 per thousand inhabitants, and the fertility rate decreased by 23% to 2.2 children per woman. [4]

This brief summary of population health indicators describes a generally positive trend: an increase of life expectancy and a reduction in infant mortality. However, it is important to place the gains in perspective: over the same time period, global life expectancy at birth increased by 5.1 years, from 66.9 in 1997 to 72.0 in 2016. Restricting the analysis to upper-middle income countries (of which Mexico is one), life expectancy at birth increased by 5 years, from 70 to 75, similar to the increase observed in Latin America and the Caribbean,[5] suggesting that Mexico's increase of 2.7 years is relatively low.

Mexico has experienced a dissonant epidemiological transition process. Although infant and maternal mortality rates were reduced, mortality among adults associated with non-communicable diseases and violence has increased, resulting in an increase in the crude mortality rate (Gómez-Dantés *et al*., 2016). This is due to social inequalities in health that are manifested as differential access to health, and health outcomes related to socioeconomic conditions of the population (Gutiérrez and García-Saisó, 2016).

Global burden of disease studies capture the national epidemiological profile and its evolution over time. Between 1997 and 2016, changes were observed in the main causes of disability-adjusted life years (DALYs). In 1997, the top five causes were: lower respiratory infections, neonatal preterm birth, diabetes mellitus type 2, ischemic heart disease, and diarrheal diseases. By 2017, they were: diabetes mellitus type 2, ischemic heart disease, physical violence by other means, physical violence by firearm, and migraine. Diabetes moved from 3rd to 1st place. In 1997 three of the top five were infectious/neonatal and two were chronic disease. By 2017 none were infectious/neonatal and two were violence.[6]

[4] CONAPO. Demographic Indicators in Mexico 1990 to 2050. Consulted on 09/15/2018 in http://www.conapo.gob.mx/work/models/CONAPO/Mapa_Ind_Dem/index_2.html

[5] World Bank. Data from the World Bank. Consulted on 09/15/2018 in https://datos.bancomundial.org/indicador/sp.dyn.le00.in?end=2016&start=1997&year_low_desc=true

[6] Global Burden of Disease Study. Results for Mexico. Consulted on 09/15/2018 in https://vizhub.healthdata.org/gbd-compare/

The role of the non-communicable disease as a population health challenge is central because, among other reasons, these diseases exacerbate social inequalities and reduce the well-being of populations living in poverty. For instance, individuals in the top income quintile are more likely to be diagnosed with diabetes, the leading cause of DALYs nationally, due to better health care access. However, populations living in poverty have a greater risk for diabetes, and once the disease is diagnosed the probability of experiencing complications increases up to 18 percentage points, in comparison to the population with the highest income quintile (Gutiérrez… [*et al.*], 2016b).

Similarly, national health surveys indicate that the presence of at least one person with a diagnosis of diabetes and/or hypertension increases the resources allocated to health as a percentage of total household expenditure. This increase is greater among households in the lowest income quintile (Gutierrez, Garcia-Saiso and Aracena, 2018), exacerbating social inequalities and contributing to a decrease in well-being among populations living in poverty.

Two events have progressed in tandem with these national trends that are relevant for the accumulation of human capital: the overweight and obesity epidemic and trends in teenage pregnancy. The following subsections discuss these subjects in further detail.

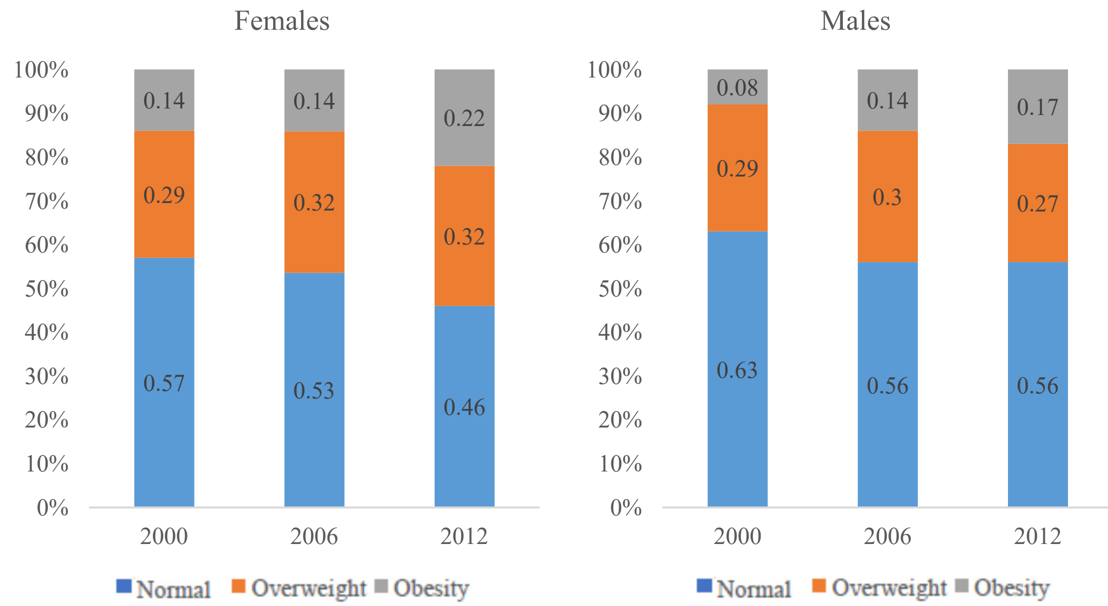
### *A. Overweight and obesity*

The trends of increasing prevalence of overweight and obesity are related to the challenge of combatting the diabetes epidemic in Mexico. Between 1999 and 2016, the combined prevalence of overweight and obesity among Mexican adult women increased from 61.0% to 73.8%; among girls ages 5 to 11 it increased from 22.8% to 32.8%; and for adolescent women ages 12 to 19 it increased from 28.3% to 39.2% (Shamah-Levy et al., 2018; Uribe-Carvajal et al., 2018). Despite the high prevalence of overweight and obesity in 1999, the situation has worsened over time. In the 2006, 2012, and 2016 National Health and Nutrition Survey (ENSANUT in Spanish), datasets in which the PROSPERA population could be identified, the difference between the prevalence of overweight and obesity among the program's population and among the general population with an equivalent socioeconomic status who did not participate in the program are not significant.

We are able to identify important trends in the health conditions of populations with lower socioeconomic levels by analyzing the 2000 National Health Survey (ENSA) and the 2006 and 2012 ENSANUT, and by narrowing down our analysis to the 20 to 24 age group and the villages with relatively greater presence of the program. (Valdespino et al., 2003; Olaiz-Fernández et al., 2006; Gutiérrez et al., 2012).

Figure 1 shows that between 2000 and 2012, there is a decrease in the percentage of the population 20-24 years of age with a healthy (normal) body mass index (BMI between 18.5 and 24.9) for both males and females. At the same time, there is an increase in the proportion of the population categorized as obese. Over this time period, the overweight category remains relatively constant.

**Figure 1.** Trends in the categories of body mass index in adult persons between 20 to 24 years of age by gender. Mexico 2000, 2006 and 2012.

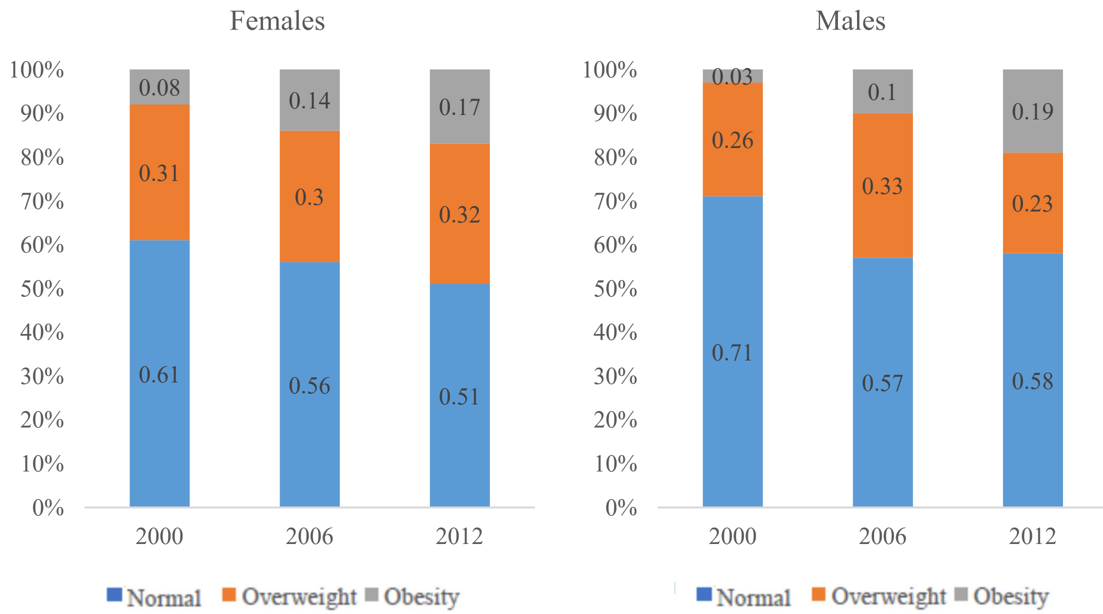



Source: Authors' estimates based on data from the National Health Survey 2000 (ENSA 2000), National Health and Nutrition Survey 2006 (ENSANUT 2006) and the National Health and Nutrition Survey 2012 (ENSANUT, 2012).

When performing the same analysis on the population group relevant to PROSPERA, the lowest income quintile, the increase in the prevalence of obesity was even more pronounced. As shown in Figure 2, between 2000 and 2012, the percentage obese of those in the lowest income quantile increased from 8% to 17% for females and 3% to 19% for males, which corresponds to a 113% and 533% increase in obesity, respectively.

It is important to highlight that while the prevalence of overweight and obesity has increased in recent years, the population prevalence of these conditions in Mexico was already high in 2000. In other words, the growing trend of overweight and obesity precedes PROSPERA and, in this sense, is part of the context in which the program was developed and is part of the ongoing epidemiological transition in Mexico.

**Figure 2.** Trends in the categories of body mass index in adult persons between 20 to 24 years of age of the lowest income quintile by gender. Mexico 2000, 2006 and 2012.




Source: Authors' estimates based on data from the National Health Survey 2000 (ENSA 2000), National Health and Nutrition Survey 2006 (ENSANUT 2006) and the National Health and Nutrition Survey 2012 (ENSANUT, 2012).

*B. Teenage pregnancy*

Another subject of specific relevance is pregnancy during adolescence. According to the ENSA and ENSANUT, the probability of teenage pregnancy increased from 9.3% to 10.7% between 2000 and 2012. The increase in teenage pregnancy occurred despite the fact that the prevalence of contraceptive use also increased and is thus attributed to the fact that an even greater proportion of teens reported having initiated sexual activity.

The analysis controlling for socioeconomic status showed that in 2000 the probability of pregnancy among adolescents who had initiated sexual activity was 20 percentage points higher for adolescents in the lowest income quintile compared to those in the highest income quintile. Moreover, this gap increased to 33 percentage points in 2012. Although the likelihood of having sex was higher among adolescents who live in higher income households, this group was also more likely to report the use of protection to prevent pregnancies (Gutiérrez et al., 2016a). Despite these disparities, the 2012 ENSANUT analysis suggests that the increase in the fertility rate for teens aged 15 to 19 occurred to a lesser extent among adolescents in PROSPERA households compared to adolescents in the two poorest income quantiles in households that did not receive aid from PROSPERA.

## III. PROSPERA's theory of change from the social mobility perspective

The starting point for intergenerational mobility analysis in health and education attributable to PROSPERA is understanding the degree to which mobility is part of the program's foundations. In this section we first review PROSPERA´s theory of change, discuss how the program is expected to contribute to intergenerational mobility, and briefly summarize some of the available evidence on the program's chain of results (we note that this evidence is not exhaustive).

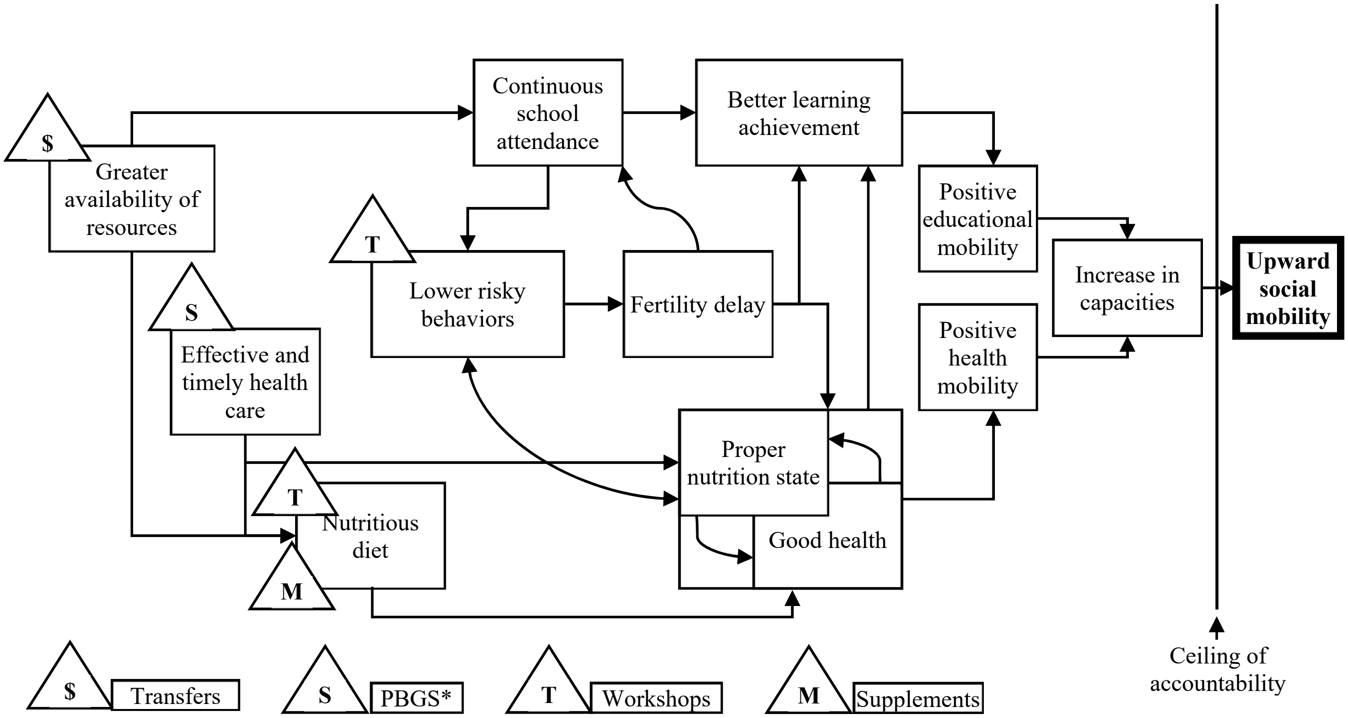
In Figure 3 we describe our version of PROSPERA's theory of change, which highlights intergenerational social mobility. Briefly, this model postulates that the program's contribution to upward social mobility is through an increase in program participants' capabilities (greater human capital) as a result of the positive mobility in health and education.

While transfer programs in general are designed to promote the adoption of healthy behaviors, these must be complemented by supply-side actions by public service providers (Ranganathan and Lagarde, 2012). The chain of results assumes an adequate level of quality in health and educational services provided to the population. However, the available evidence points to structural deficiencies that compromise the quality and coverage of care (Gutiérrez, 2012a). For example, the number of prenatal care procedures performed is below those recommended, and they are even lower in women from poorer households (Barber, Bertozzi and Gertler, 2007). In general, evidence shows that the greatest potential of the conditional cash transfer program is its ability to increase human capital through the synergy between cash transfers and non-monetary program components (such as supply-side strengthening) during critical periods for growth and development (Leroy, Ruel and Verhofstadt, 2009).

Following the theory of change, improvement in health is the result of proper nutrition and healthy environments, which are pre-conditions or intermediate results of effective and timely health care access, a nutritious diet, reduction in risky health behaviors, and postponed parenthood, among others. These same conditions, combined with continuous school attendance, influence the participants' learning achievement and are in turn associated with educational mobility.

Likewise, regular school attendance can modify youth's temporal preferences, promoting the accumulation of knowledge and a reduction in risky health behaviors (Sigmon and Patrick, 2012). Specifically, knowledge of contraceptive methods, the availability of services though Mexico's Guaranteed Basic Health Package (PBGS), and the reduction of unprotected sexual intercourse favor the postponement of parenthood. Delaying fertility also influences school attendance when adolescents have access to education, implying a feedback loop and bidirectional relationship between these outcomes. These educational opportunities are also improved when the household has greater economic resources (both because the households can help the children attend school and because they can forego the income from child labor). This last element is influenced by the main intervention of PROSPERA: cash transfers conditioned on regular school attendance.

Figure 3. Proposed theory of change for PROSPERA: Focused on increasing social mobility
*PBGS: Basic Guaranteed Health Package Source




Source: Created by the authors

Short- and medium-term evaluations have documented the results chain on the initial phases of PROSPERA's theory of change. With regard to health, the short-term evaluation carried out between 1998 and 2000 identified a 25% reduction in illness episodes among children who received support from the program during their first six months of life. These effects increased thereafter with exposure to the program. The evaluation also identified a 25% reduction in the prevalence of anemia and a 1 cm or more growth increase in children during their first year of life (Gertler, 2004; Rivera et al., 2004; Behrman and Hoddinott, 2005; Cecchini and Soares, 2015). It was estimated that this additional growth would result in a 2.9% increase in permanent income during adulthood (Behrman and Hoddinott, 2005).

Research on transfer programs has consistently shown positive effects on prenatal care, improved care during labor and delivery, reduction in low birth weight (Glassman et al., 2013), and general positive infant mortality outcomes. An ecological analysis that uses the staggered growth of the program at a municipal level in the country, identified a 17% reduction in the infant mortality rate (IMR) among the beneficiary population in rural areas, and an 8% reduction in IMR across all municipalities with program beneficiary population (Barham, 2011).

A greater use of public sector health services and reduction in the use of private health services was documented in the mid-term evaluation, which translated into lower household health expenditures. PROSPERA's increased promotion of preventive services was accompanied by an observed reduction of two sick days annually per family for persons between 0 and 5 years of age, and a reduction of six days annually per family for persons between 16 and 49 years of age (Gutierrez, Bautista, et al., 2005). A reduction in the prevalence of overweight boys and girls was also observed (Fernald, Gertler and Neufeld, 2008 and 2009).

According to the theory of change, PROSPERA affects fertility through direct and indirect mechanisms: directly, through greater access to contraceptive methods via the PBGS and also by information on pregnancy prevention through workshops on health self-care; indirectly, by reducing school dropout and influencing educational expectations and valuation of education, modifying youth's use of time and potentially decreasing their discount rate.

Fertility and, in particular, the age at which women bore their first child, are relevant measures both for their direct effects on women's wellbeing, as well as for her ability to build human capital. Early pregnancy is associated with school dropout and lower future income. PROSPERA has contributed to delaying initiation of childbearing according to the mid-term evaluations (Andalón, 2011). Furthermore, PROSPERA is also associated with a delay in initiation of sexual intercourse, which is an indicator associated with the delay of first pregnancy (Gutierrez, Gertler, et al., 2005; Gutierrez-Reyes, 2007; Gutiérrez, 2012b) and with lower probability of pregnancy due to the increase in age at first intercourse and an increase in condom use (Gutierrez, 2008). Additionally, conditional cash transfers programs are associated with a reduction in the prevalence of sexually transmitted infections (de Walque et al., 2012; Bertozzi and Gutiérrez, 2013; Cluver et al, 2013).

In terms of education indicators, evaluations have documented an earlier starting age for school, increases in middle school and high school enrollment rates, reduction in school dropout, and increases in completed school years. In terms of years of education attained, six years of exposure to the program was associated with an additional year of schooling (Parker and Todd, 2017). In addition, these positive results were especially pronounced at the transition from primary to middle school ($6^{th}$ to $7^{th}$ grade) a time of especially high drop-out when the program began. Now the critical period is at the transition from middle to high school ($9^{th}$ to $10^{th}$ grade).

Engaging in risky behaviors and earlier initiation of such behaviors affect the formation of human capital. Alcohol and tobacco consumption are among the risky behaviors that deteriorate health capital. In a 2003 evaluation, PROSPERA was associated with a 14% and 13% decrease in the probability of smoking and consuming alcohol, respectively. Ten years later, the reduction in the likelihood of smoking and consuming alcohol persisted. Furthermore, it was found that exposure to the program for a longer period increased this reduction (Gutierrez, 2008).

The above evidence supports the program's potential to increase the accumulation of human capital among the members of beneficiary households, specifically, among those who benefited during critical periods in growth and development. However, there is still need to collect evidence on the program's potential to reduce poverty and inequality in the long-term. Such evidence would allow us to determine whether an increase in human capital due to being raised in a household benefiting from a conditional cash transfer program will actually be reflected as higher income in adulthood (McKee and Todd, 2011).

The last link of the results chain seeks to determine whether there is a positive return on investment in human capital. In other words, we investigate whether greater accumulation of health and education capital is reflected in higher income. Among the general population in Mexico, positive returns on investment in health and education have been found (Gutierrez, 2012), consequently, we would expect that these results also occur among PROSPERA's beneficiary population.

In summary, we find evidence of the effectiveness of PROSPERA in improving both health and education, including better health conditions, lower levels of participation in risky behaviors, and greater school attendance and progression. This evidence is the starting point of the long-term analysis.

## IV. Height as a measure of health capital and intergenerational mobility

Generally, measures used to establish an individual's health status refer to the person at the time of assessment and reflect episodes of communicable and non-communicable illness, as well as accidents and similar events. Those measures do not reflect the accumulated level of health (health capital) over time.

A measure of accumulated health that has been used in the international literature, and that considers the individual's growth and development process, is maximum height achieved. In recent literature, elements of variability in height that go beyond genetic traits, such as the role of nutrition and exposure to infections during the growing periods, have been analyzed. Maximum height achieved reflects genetic and epigenetic variations among individuals, and is influenced by exposure during development to diseases, nutrition, hygiene practices, and behaviors that affect health (Bhalotra and Rawlings, 2013; Habicht *et al*., 1974).

Population variability in height beyond genetic factors is clearly observed in middle- and low-income contexts, while a greater proportion of higher-income populations' height variation is determined by genetic factors.[7] Height, in this sense, reflects the health and nutrition conditions a child experienced during growth, which is also a measure of investment in that child's health capital. (Alacevich and Tarozzi, 2017; LaFave and Thomas, 2017; Case and Paxson, 2008)

Thus, height is an indicator that reflects the accumulated history of health and nutrition throughout stages of an individual's growth and development. Particular emphasis has been placed on the importance of the first 1,000 days of life, from gestation to age two, and their implications in the child's future well-being (Cameron and Demerath, 2002; Sanders, 2013), however, this is not the only relevant period for the accumulation of human capital (Prentice *et al*., 2013).

Childhood is a critical moment for development, specifically in terms of height, with rapid growth periods in early childhood (0 to 2 years of age), mid-childhood (6 to 8 years of age) and adolescence, with the appearance of secondary sexual characteristics as indicators for the end of the period of accelerated growth, this is, around 13 or 14 years of age (Cameron and Demerath, 2002; Butler, 2007). In addition, the same age periods are critical for brain development, which occurs rapidly in the first years of life and is affected by external factors that may have lifelong cognitive and social repercussions (Grantham-McGregor *et al*., 2007). Mid-childhood (6 to 8 years of age) and adolescence are also critical periods for brain development and maturity. It has been estimated that at 13 years of age the maximum point of development in all parts of the brain has been reached (Shaw *et al*., 2008; Grantham-McGregor *et al*., 2007)

Some studies have proposed that there is a potential for growth recovery that would allow individuals to achieve the height of those with better conditions during early childhood, although they indicate that such potential is highly context-dependent (Anand *et al*., 2018; Prentice *et al*., 2013; Desmond and Casale, 2017). These studies have proposed that the mother's height and schooling, as well as household socioeconomic conditions, are related to this potential (Desmond

[7] In Mexico, the variability in height explained by genetic differences is relatively minor because of centuries of intermarriage between people of European and indigenous heritage with the result that the Mexican population is relatively homogeneous genetically (Gorodezky *et al*., 2001; Salazar-Flores *et al*., 2015).r

and Casale, 2017). However, such studies lack longitudinal data as they do not monitor cohorts over time. This makes it difficult to identify the factors that contribute to the development of growth potential.

Moreover, there is evidence detailing the negative effects of certain risk behaviors on health. In particular, the consumption of addictive substances like cigarettes, alcohol and other drugs during a critical stage for growth have shown negative effects on height and cognitive development (Berkey *et al*., 1984; Jedrychowski, Maugeri and Jedrychowska-Bianchi, 2002; Carter *et al*., 2016; Karama *et al*., 2015).

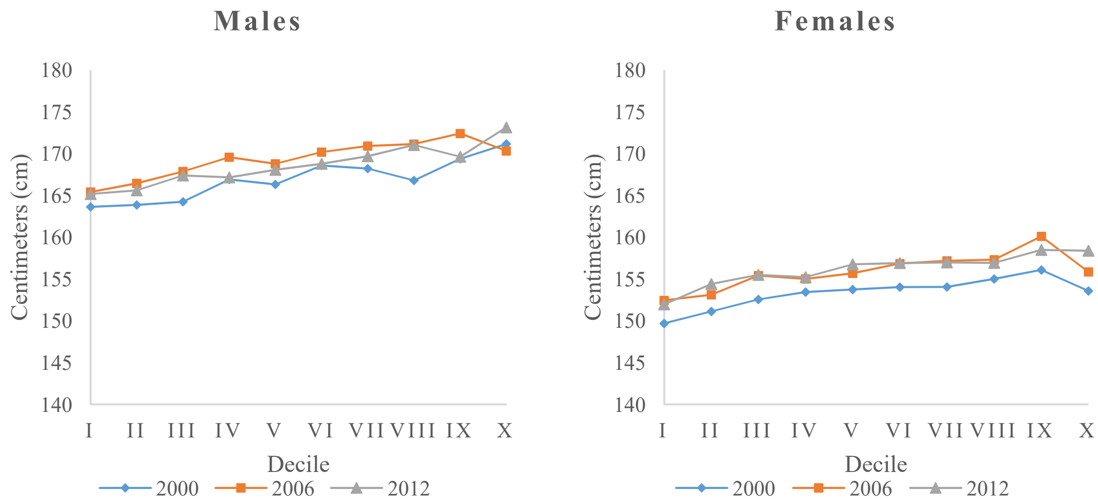
In Mexico, as in other countries, an increasing trend in the height of the general population has been observed (Malina *et al*., 2004). Figure 4 shows the average height by deciles of income for the Mexican population between 20 and 24 years of age for 2000, 2006 and 2012.[8]

Between 2000 and 2012, the average height of the population aged 20 to 24 years increased by 1.18 cm (0.71%) among men and 1.84 cm (1.20%) among women. The differences between the deciles 1 and 10 have remained relatively constant over time: approximately 4.8 cm for women and 6.3 cm for men. This period represents a subset of time during which PROSPERA has operated. There has been an increase in the average height of individuals at a national level, maintaining a similar gap by socioeconomic level.

Height has been used as a measure of capital by others, using its historical trends as a measure of nations' development (Fogel, 1994). Several studies have analyzed the relation between height and income, identifying positive and significant health returns in low- and middle-income countries (Schultz, 2002; Strauss and Thomas, 1998; Thomas and Strauss, 1997).

[8] The ENSANUT MC 2016 is not used due to the limited scope of the survey (focused on nutrition); the data collected on socioeconomic aspects were very limited, and it is not possible to divide the population by socioeconomic deciles or quintiles for analyses.

**Figure 4.** Average height of youth between 20 and 24 years of age in Mexico in 2000, 2006 and 2012, by gender and income decile




Source: estimations of the authors based on the data from the National Health Survey 2000 (ENSA 2000), National Health and Nutrition Survey 2006 (ENSANUT 2006) and the National Health and Nutrition Survey 2012 (ENSANUT, 2012).

### *A. Intergenerational mobility*

Studies on intergenerational mobility have thus far ignored health, despite its central importance in well-being (Halliday, Mazumder and Wong, 2018). We hypothesize that this is mainly due to the difficulty of obtaining data on a longitudinal panel that includes health indicators. This study incorporates health as a measure of intergenerational mobility and contributes to addressing this gap in the intergenerational mobility literature.

The mobility literature that intersects with health has noted that health conditions are important determinants of income differentials and that inequality in income tends to be correlated between generations, in part due to the intergenerational associations between education and health (Ahlburg, 1998).

Recently, the importance of analyzing intergenerational mobility in health to understand the persistence in socioeconomic differentials has been emphasized. This area of study seeks to identify the specific role that transmission of health status plays as a determinant of social mobility (Akbulut-Yuksel and Kugler, 2016). Some analyses have also documented the transmission potential of risk behaviors for health, indicating that parental behaviors tend to be replicated by adolescents, and specifically follow a transmission pattern from father to son and mother to daughter (Wickrama et al., 1999).

In Mexico, recent studies have found low intergenerational social mobility, characterized by intergenerational transmission that is greater for health than for education, which parallels the existence of an intergenerational correlation in life expectancy (Delajara et al., 2018; Moreno-Jaimes, 2017). According to the literature, the degree of persistence in health between generations is affected by the context in which someone is born and where their child and youth development occurs. Hence, there is a greater persistence of poor health when the beginning of life occurs under conditions of socioeconomic vulnerability (Bhalotra and Rawlings, 2013) .

An increase in height between generations (in a stable population without significant in- or out-migration) is associated with better welfare conditions (McKee and Todd, 2011). This paper analyzes absolute intergenerational mobility (change of height between generations) and relative intergenerational mobility, defined as the degree to which parental height does *not* predict the height of children.

## V. Data

We use the Evaluation of Rural Households Survey (ENCEL) 2017. ENCEL 2017 collected data on youth, heads of household,[9] and characteristics of both the individual's household of origin and his/her new household.[10] Additionally, data from the Socioeconomic Characteristics of the Households Survey (ENCASEH) 1997 as well as the 1998 to 2000 ENCEL longitudinal surveys were used. ENCEL 2017 was established as a follow-up to a subsample of individuals from the 1997-2000 ENCASEH, to analyze elements of social mobility. Individuals who were in critical periods of growth and development when the program initiated were selected: those who could have received PROSPERA transfers during the first 1,000 days of life (under two years old), those who were about to start primary education (6 to 8 years old), or those who were transitioning to middle school (enrolled in the sixth grade). Measurements of intergenerational mobility are based on the comparisons of results between these youth and the people who, when the youth were 14 years old, were the primary household providers (hereafter referred to as 'the providers').

The sample was drawn from individuals in the three age categories identified from prior evaluation surveys and administrative registers.[11] The procedure ENCEL 2017 followed consisted of initially visiting the selected young adult's households of origin, that is, the households they resided in between 1997 and 2000. When the original household was located, a survey was administered that collected data on: housing characteristics, household composition, each of the original household's members, and each new resident.

Additionally, we requested the young adult's location and the location of the person who contributed the most to household income (the provider) when the young adult was 14 years old. If the young adult and/or provider remained in the original household, they were interviewed with specific individual questionnaires. If they were no longer part of the original household, a follow-up was carried out if they resided in: the same village, in villages within a maximum half hour travel radius from the village of origin, in villages within the survey's working routes, in the main cities of the 7 regions in the sample, or in the main metropolitan areas of the country.

ENCEL 2017 was carried out in November and December of 2017. Eleven thousand youth were selected and 4,663 (42.2%) were interviewed. Of the non-interviewed, the majority were youth who were not living in their original household (24%), followed by those who were not found (14%), and by those who were reported as migrants (11%). To increase the sample size, a second interview phase was carried out in 2018, during which 1,582 additional youth were interviewed.

[9] In ENCEL 2017 "provider" was defined as someone who provided the greater part of the household's expenditure when the young adult was 14 years old; typically, the father or the mother.
[10] In ENCEL 2017 "new household" was defined as the household created by a selected young adult.
[11] The detailed methodology of the ENCEL 2017 is presented in the specific document of the National Institute of Public Health (INSP) 2017.

An important element of the analysis is the potential bias introduced by the non-response rate in ENCEL 2017. It should be noted that with a twenty-year follow-up period, significant loss to follow-up is expected.

The sample does not consider those who emigrated to other countries, specifically the group reported to reside in the United States. We note that on average, Mexican migrants in the US have higher incomes compared to those who remain in Mexico (Yaschine, 2015; González de la Rocha, 2008).

*A. Variables*

The unit of analysis used is the youth who resided in rural households in the evaluation during 1997-2000 and who were also ENCEL 2017 respondents. Among the youth in ENCEL 2017, we are particularly interested in the cases in which the interviewee was also the main household provider when the participant was 14 years old. This allows us to assess intergenerational mobility (Velez-Grajales, Huerta-Wong and Campos-Vázquez, 2015; Torche and Wormald, 2004). Overall, data on 4,578 pairs (youth and provider) is available, although due to missing values some estimations have fewer observations. From this group of pairs (youth and provider), we identified the household of origin to include household baseline characteristics in the analysis for the period 1997-2000.

As part of ENCEL 2017, anthropometric measurements were completed; specifically height and weight were measured for the interviewed youth and their providers. Furthermore, fluid intelligence (Raven matrices) and memory tests were performed. The instruments developed enabled us to collect information on household providers, both from the direct interview as well as from youth's responses.

Table A.1 of Appendix A lists the main variables of interest for the analysis.

Based on factors such as growth, development and schooling as seen in section IV, individuals 15 years or older when their households began receiving PROSPERA's transfers were already at a moment in their growth, development and education that limited the ability of the conditional cash transfers to influence the formation of their human capital. With respect to educational capital, this is supported by findings from a PROSPERA evaluation which demonstrated that the possibilities of re-incorporating those who have already dropped out of school are relatively lower at all ages (although they exist) and virtually nonexistent as of 14 years of age (Behrman, Sengupta and Todd, 2005).

Therefore, individuals 15 years and older serve as a potential comparison group because they share similar conditions and contexts as the other age groups in the same villages, but with very limited possibilities of additional human capital formation due to PROSPERA's transfers. Thus, this group had limited program exposure because they were no longer in a critical period of human capital formation when their household was exposed to the program.

The analyses performed take advantage of the variation in exposure to the program. Considering the different age groups in ENCEL 2017, we can compare individuals who participated in the program at different critical periods of human capital development through the life course (i.e. early childhood, mid-childhood and early adolescence). In this manner, the oldest group (15 years or more) is used as a comparison group for the age groups that had greater exposure. The groups used for the analysis are defined as follows:

**Group 0**: Individuals with a reported age of 35 to 55 years in ENCEL 2017. In the analysis, this group is considered the control as they had no exposure to PROSPERA during a critical period for development of human capital.

**Group 1**: Individuals with a reported age of 17 to 21 years of age in ENCEL 2017.

**Group 2**: Individuals with a reported age of 22 to 28 years of age in ENCEL 2017.

**Group 3**: Individuals with a reported age of 29 to 34 years of age in ENCEL 2017.

Groups 1, 2 and 3 comprise the groups exposed to PROSPERA during critical periods of human capital development, that is, from birth to 15 years of age during the period 1997 to 2000.

Table B.1 in Appendix B presents the main descriptive statistics for the interviewed youth, both as a whole and stratified by age groups. Of the total youth interviewed, 55.3% were women, and the average age was 27.8 years for males and 27.9 years for females. The average BMI was 26.0 for males and 26.5 for females, in both cases over the healthy limit (greater than 24.9). Males have 8.6 average years of schooling and females have 8.7; 91% of the males and 35% of females report being employed; and 17% of the males and 11% of the females do not have health insurance.

In terms of fertility, 75% of females reported having already been pregnant, 42% became pregnant at age 19 or earlier, and the average age of first pregnancy was 20.2 years. Among males, 12% indicated that by the time they were 19 years old they had already had a child and the average age when they had their first child was 22.4.

In terms of risk behaviors, 90% of males reported having consumed alcohol, 43% having smoked, and 10% having tried marijuana, which in the case of females occurs for 61%, 8% and 1% of them, respectively. These figures are consistent with those reported in national surveys (INPRF-INSP-Conadic, 2017b, c, a).[12]

Table B.2 of Appendix B presents household providers' main characteristics, as a whole and stratified by the age groups of the youth for whom they were providers. When compared to Table B.1, we observe that providers are on average 30 years older their children and, as expected, the average age is higher for providers of older youth groups, maintaining the same average difference of 30 years.

In terms of the main health indicator, height, we observe that the maximum height of providers is 2.8 cm lower for males, and 3.9 cm lower for females, compared to youth (Table B.1). When considering the relationship between height and weight, it is observed that the average body mass index (BMI) for males and females is in the overweight category, and as observed in the general population based on the national surveys, average BMI is higher for females than for males.

Cognitive and memory tests were performed when collecting data for ENCEL 2017; there is no estimate of these tests for the youth or providers at previous ages. Due to the cognitive deterioration expected with age (Cline *et al*., 1989), the providers' age partly explains this group's lower cognitive scores relative to the youth's. While in the cognitive tests no differences are observed by gender, the memory score is higher for males in all cases.

The average years of schooling of providers, 3.6 for males and 3.4 for females, is consistent with the data registered by the 1995 Population and Housing Census in rural villages.

[12] National Institute of Psychiatry Ramón de la Fuente Muñiz (INPRF), and the National Commission against Addictions (Conadic).

This population reports high levels of health insurance coverage, mainly through Seguro Popular, resulting in a lower percentage of uninsured compared to the Mexico's general population.

Among the providers, 87% of males and 43% of females report engaging in economic activities; 35% of males and 31% of females report speaking an indigenous language; and 5% of males and 8% of females, reported having a disability.

In the absence of a previous measurement, the maximum height of the provider is estimated based on age, gender, and height observed in 2017 using the equation proposed by Cline (Cline *et al*., 1989; Fernihough and McGovern, 2015).

The analysis methodology is outlined in sections VI.A to VI.C. First, we investigate potential mobility, that is, the intergenerational mobility that is not predicted by the providers' height and schooling.

Thereafter, we identified the absolute magnitude of intergenerational mobility in height and years of schooling, as measures of health and educational capital accumulation. To measure intergenerational mobility, we consider the difference in the outcome between an individual and the economic provider when the youth was 14 years old, provided they were the same gender. We then estimate the effect of PROSPERA on absolute mobility using various health and education indicators through a propensity score matching model.

Finally, we estimate labor income returns to improvements in health and education.

## VI. Methodology

### *A. Mobility analysis*

We begin by analyzing two related aspects of intergenerational mobility: first, we examine the possibility of intergenerational mobility in health and education within the PROSPERA population. For this population, we estimate the proportion of an individuals' mobility that is not explained by provider, using the indicators' absolute values. Second, we estimate intergenerational mobility using the relative position of the youth and providers (degree of persistence in relative-positional terms within the group). Both approaches are explained in greater detail below.

Relative intergenerational mobility is typically estimated as the intergenerational elasticity, which is the coefficient of the relationship between the levels of the youth's and the provider's results, interpreted as a measurement of persistence between generations in the interest indicator (Chetty *et al*., 2014). Our estimation is based on the general model proposed in the literature, adapted to consider health indicators (instead of income) (Akbulut-Yuksel and Kugler, 2016; Corak, 2013),

$$S_{1i} = \alpha + \rho S_{0i} + \beta X_i + \epsilon_i \quad (1)$$

Where $S_{1i}$ is the youth's health indicator, $S_{0i}$ is the provider's health indicator (for example youth's height and provider's height respectively), $X_i$ is a vector of provider and youth covariates, $\alpha$ is the intercept, and $\epsilon_i$ is a normally distributed error term.

Equation (1) represents the reduced form in which ρ measures the degree of persistence of the health or education indicator between generations. ρ is bounded between 0 and 1, with lower values of ρ representing lower persistence of the indicator. Thus, the relative mobility is defined as 1-ρ.

When using maximum height as the health indicator, it is necessary to consider genetic and epigenetic determinants. That is, in addition to showing that investment during the youth's growth impacts height, we must also consider that the persistence in height between generations may not be zero, for biological reasons. However, the intergenerational persistence of other indicators, such as education and other health measures that are less determined by genetics, may be closer to zero.

When analyzing height, an additional consideration is that of kinship: genetic transmission between provider and youth is clearly more important for the case of pairs of mothers or fathers with their children. In the available data, for 90% of the analyzed cases, the provider is the youth's mother or father. As mobility refers to the effect of the household of origin and life conditions on the individual's outcomes, we use the full sample and not only the pairs where the provider is a biological parent of the youth.

A consideration for the estimations of the mobility potential is the fact that younger groups both have higher exposure to the program and may still be in the process of generating human capital (that is, still studying and/or growing). This is interpreted as a type of data censorship, where the maximum or final value of the dependent variable is not observed, and instead we observe the value at the moment the variable was measured.

In light of the potential censorship that would primarily affect the younger group, the estimation of equation (1) by ordinary least squares (OLS) may introduce a bias in the coefficient of persistence, as censorship reduces the variance of the censored variable. Here we expect right-censorship, which results in the mean of the censored variable being lower than if it was non-censored (Greene, 1999).

Thus, we also estimate a tobit model that considers observations of the height indicator as censored if the individual was under 22 year of age, and considers education observations as censored if the individual was attending school at the time of ENCEL 2017. While all observations could be considered censored if we believe individuals may return to school at any time, but the evidence of the prior evaluations of PROSPERA show that this is unlikely.[13]

Another way to analyze intergenerational mobility is to examine the relative position of the individuals in both generations using a rank-rank model, in line with recent literature (Chetty *et al*., 2014; Halliday, Mazumder and Wong, 2018). This estimation reduces the influence of extreme values:

$$r_{1i} = \alpha + \rho r_{0i} + \epsilon_i \qquad (2)$$

Where $r_{1i}$ is the relative position of individual $i$'s indicator variable (height or schooling) among the set of youth; $r_{0i}$ is the relative position of provider $i$'s indicator variable (height or schooling) among the set of providers; and $\epsilon_i$ is a normally distributed error term.

Here, $\rho$ refers to the degree of persistence in the relative position, instead of persistence in absolute value, as in equation (1). Mobility is again defined as 1- $\rho$, but here it is a measurement

[13]For the case of height, 695 observations with censorship are considered, that is, persons who may grow more than the observed value. For the case of education 152 observations with censorship are considered, that is, those who could accumulate years of schooling beyond observed years.

of mobility in position or rank. Relative models, such as equation (2) tend to generate more stable estimations than models that use levels (Dahl and DeLeire 2008).

In addition, to consider the joint determination of building human capital, the equations for relative mobility for health and education in a rank-rank format were simultaneously estimated, in line with the proposal of (Zellner and Theil, 1962). Here, the error terms are correlated across equations if the type of mobility[14] being analyzed (e.g. schooling) influences mobility along the other dimension (e.g. height) (Greene, 1999):

$$r_{s1i} = \alpha + \rho r_{s0i} + \beta r_{e1i} + \epsilon_{si} \quad (3)$$

$$r_{e1i} = \alpha + \delta r_{e0i} + \gamma r_{s1i} + \epsilon_{ei} \quad (4)$$

Where $r_{s1i}$ and $r_{e1i}$ are the relative positions of individual *i's* height and schooling, respectively, among the set of selected youth. Equivalently, $r_{s0i}$ and $r_{e0i}$ are the relative position of provider *i's* height and schooling, respectively, among the set of selected providers. $\rho$ and $\delta$ measure the persistence of the provider's relative height and schooling, and measures the $\delta$ persistence of youth $i$'s height. $\epsilon_{si}$ and $\epsilon_{ei}$ are the error terms. The correlation between errors is verified through the Breush-Pagan test.

The magnitude of the mobility observed in the PROSPERA population is estimated using absolute mobility, which measures through a simple difference the level change of the indicator between youth and provider (Chetty *et al*., 2014). Height differences by gender must be considered, so the estimation uses only observations where youth and provider are the same gender. While absolute mobility analysis should use information on changes in position for the entire available population, here, due to the necessity of using only gender-matched pairs, we focus on the average value of intergenerational mobility. In this respect, the estimation is simply:

$$Mobility_i = S_{1i} - S_{0i} \quad (5)$$

Where $S_{1i}$ refers to the level in the youth's variable and $S_{0i}$ to the level of the provider's variable.

*B. Estimation of the effects of PROSPERA*

To estimate the contribution of PROSPERA to mobility we use propensity score matching. This is necessary to guarantee the similarity between the observable characteristics of the analyzed age groups and the comparison groups (more than 15 years of age in 1997). First, we generate the propensity score itself from the baseline characteristics (e.g. observable characteristics in 1997) that are determinants of individuals' participation in the intervention (PROSPERA). This score is computed for both participants and non-participants in PROSPERA. The comparison group is thus composed of individuals with similar propensity scores, who did not receive the intervention (Heckman, Ichimura and Todd, 1997; Rosenbaum and Rubin, 1983). Comparing the two groups matched by propensity score allows us to estimate the effect of the intervention.

The propensity score estimates the conditional probability of participating in PROSPERA given observed baseline characteristics; when observations are matched with scores of similar magnitudes the matching is more efficient (Ravallion, 2001; Khandker, Koolwal and Samad Hussain A., 2010). This method is based on observable characteristics, so we therefore must

[14]This case refers to health and education.

assume that the differences in the non-observable characteristics are not relevant. Formally, the propensity score is defined as:

$$P(X_i) = Pr(D_i = 1|X_i) \qquad (6)$$

where $P(\cdot)$ is the propensity score; $X_i$ is a vector of length $k$, which contains $k$ observable baseline characteristics of the individual; $D_i$ is an indicator variable for the intervention, here, the exposure to PROSPERA in critical human capital time-windows, and $Pr(D_i = 1|X_i)$ is, by definition, the probability that the $i$th individual was exposed to PROSPERA, conditional on their the observable characteristics, $X_i$.

This method relies on two major assumptions. First, we must assume that the observable characteristics, $X_i$, used to generate the score are, in fact, the same characteristics that determine participation in the program; implying that there are no other relevant factors that have been omitted. This assumption, known in the literature as "conditional-independence assumption", cannot be verified using quantitative methods because it is an assumption about non-observable variables. Consequently, this assumption must be supported based on the *a priori* identification of the process that leads to participation in the program.

Hence, we proposed a set of variables that we believe influence the probability of participation in PROSPERA. We do this in two ways: i) we verified the exposure of each household to PROSPERA by computing the amount of transfers received over time; and ii) we argue, based on the program's design, that what defines households' differential exposure to PROSPERA is the age of the persons within the household, and therefore, our definition of groups ensures that the assumption of program exposure during critical periods for growth and development holds.

Thus, the probability of differential exposure to PROSPERA is determined by individuals' age; the same variable that defines the analysis groups. The concern with this classification is the possibility that if age is perfectly correlated with exposure, and related to the outcomes of interest, it will not be possible to differentiate any effects of the intervention from the effects determined by the age difference.

To explain why the above does not hold in our analysis we rely on the critical periods in human capital development, namely, that this period has passed by the time an individual is 15 years old. If this window is properly identified, and, if we can assume that for individuals over 15 the initial treatment had little potential to increase their human capital, then the potential problem of spillovers effects on outcome variables is eliminated.

The second assumption, called "common support", states that there is sufficient overlap in the propensity scores of individuals in the treatment and control groups. That is, there must be some variation in treatment status among individuals with the same (or, the same within a reasonable range) probability of having received treatment conditional on their baseline characteristics. Equivalently, the intersection of the propensity between both groups is a non-empty set.

We used the following baseline characteristics (measured prior to the intervention) to conduct the propensity score matching: level of poverty in 1997 measured by the score assigned to the household by the program in 1997 and subsequent poverty classification based on that score; the two calendar months after that household received the first transfer; number of persons in the household in 1997; household income in 1997; provider's years of schooling, gender and age; and the youth's gender.

The post matching balance between treatment and control groups and evidence of common support are in Appendix C. The figures illustrate the result of the matching for both outcome variables, height and schooling, for each one of the three exposure groups. In all cases the matching improves the balance.

In the results section we report average treatment effects (ATE), which reflect the average of the differences in outcomes between individuals in the treatment group, and those in the control group. Results are similar when estimated using kernel estimators (results not presented; available upon request).

In line with the current literature, the variance of the matching estimator was bias-corrected to render it consistent and asymptotically normal (Abadie and Imbens, 2009).

In addition to the general effects, variables were included to control for the effects of belonging to a population that reported speaking an indigenous language and for the migrant population, defined as individuals who in 2017 reside in villages different from their households of origin in 1997-2000.

Considering that the model seeks to identify the effect of PROSPERA on mobility and health indicators based on the differences in time of exposure to the program during critical periods of the development of human capital, additional estimations were performed to explore to what extent the results of the model actually identify differential exposure or, result from other factors (such as the age difference).

First, the same matching scheme was implemented using provider outcome variables. Here we use variables where there should not be an observed effect of PROSPERA, either because these characteristics of the providers are predetermined with respect to the program (maximum height, basic education, results in the cognitive and memory test), and/or are characteristics we do not expect to be affected by the program (such as whether the provider speaks an indigenous language). In addition, an analysis considering the design of the original 1997-2000 experiment was performed. For this analysis, individuals who came from treatment villages of the original experiment were classified as part of the intervention group, and individuals who came from the original control villages in the comparison group.

*C. Estimation of the health returns*

To estimate the health returns we used a Mincer model (Mincer, 1974) with a Heckman selection correction (Heckman, 1979). This model identifies the returns to the human capital investment by measuring the increase in income from labor associated with higher levels of human capital, in this case, health and education:

$$\ln W_i = f(S_i E_i X_i) \qquad (7)$$

where $W_i$ is the income of individual $i$, as a function of their health level ($S_i$), education ($E_i$) and other individual characteristics ($X_i$). This general model has previously been used to estimate the returns to health and education, measured by height and years of schooling, respectively, and has generally shown positive returns (Croppenstedt and Muller, 2000; Dinda *et al*., 2006; Thomas and Strauss, 1997; Mayer-Foulkes, 2003).

The above model corrects for two difficulties presented by estimation with OLS: censorship of the labor income variable (due to non-randomized labor participation), and the potential endogeneity between income, on one side, and height and education on the other, due to omitted variable bias.

The Heckman model takes into account labor income censorship by estimating a model of the probability of earning labor income (in this case identified as the probability of labor participation), and uses this probability to correct the Mincer equation. This correction takes into account the relationship between income and the decision to work.

Due to the possible differences in labor participation by gender, separate models for males and females were estimated. In addition to the variables of the Mincer model we used an indicator for whether a member of the household is a child zero to five years of age, whether the individual has a partner, whether the individual cohabits with their partner, and for the household's income excluding the income of the individual of analysis.

The argument for endogeneity between the human capital variables and income proposes that the person with more cognitive capacity may decide to invest more in building human capital, and that they would potentially be individuals with greater social connections, which could lead to better labor opportunities with greater income. This implies that the human capital variables would be correlated to the error term in the Mincer equation (Schultz, 2002). This problem can be solved with instrumental variables; variables that are strongly related to the independent variable, and not related to the dependent variable (McFadden, 1999).

The instrumental variables methods and estimation is presented in greater detail in Appendix D. First, we verified the presence of endogeneity using Durbin and Wu-Hausman's tests. In both tests for years of study we find a p-value of 0.36, indicating that we cannot reject the null hypothesis of exogeneity. However, in the test for height we find a p-value <0.01, indicating we reject the null hypothesis of exogeneity, and must treat height as an endogenous variable.

As in previous studies (Gutierrez, 2012; Ribero and Nuñez, 2000; Schultz, 2002), to instrument for height we use variables measured at the level of the village: the *marginalization* (poverty) index of the villages in 1995 and in 2000, the total population of the villages, and 1998 prices of several food items: nixtamal (corn prepared for making tortilla dough), wheat flour, pasta, cookies, beans, eggs, sardines, sugar and oil.[15] We use an F test to test the capacity of the proposed instruments to explain the variability in height, finding that while not perfect, these instruments are reasonably strong. Finally, we tested for over-identification of the model that could result in the correlation with the error term, finding a chi square test with a p-value of 0.134, indicating that we do not reject the null hypothesis.

Using the instrumental variables for height, the estimated return model is:

$$\ln(W_i) = \beta\hat{S}_i + \delta H_i + \varphi X_i + \varepsilon_i \qquad (8)$$

$$\dot{E}_i = \gamma Z_i + u_i \qquad (9)$$

Where $\ln(W_i)$ is the natural logarithm of the income per hour reported by individual $i$; $\hat{S}_i$ is the predicted value of the health indicator from the first stage instrumental variables regression and is expressed here as the natural logarithm of height, hence the coefficient, $\delta$, is an elasticity; $H_i$ is a vector of household characteristics (including the provider); $X_i$ is a vector of individual characteristics; $\dot{E}_i$ is an indicator of individual $i$'s labor participation; and $Z_i$ is a vector of individual characteristics that determine labor market participation.

[15]The prices were collected in the village questionnaire of the ENCEL 1998-March. In the cases where the prices were not reported in the village, the average of the municipality (~ county) or state was used for the same.

## VII. Results

The results of the analysis are presented here following the same order as in the methods section. First, the potential for mobility (rank) in the PROSPERA beneficiary population is shown, then the estimation of absolute mobility in height and schooling, followed by the estimation of the effect of PROSPERA on the indicators of mobility and, finally, the estimation of the returns in labor income to the PROSPERA human capital investment.

### *A. Measurement of the potential for intergenerational mobility: What is the intergenerational mobility potential of health and education? And what is the intergenerational mobility observed?*

First, we show that there is the potential for intergenerational mobility in the population of interest. To do this, we show that the height and schooling attainment of the youth are not fully determined by their providers.

In Table 1 we show the intergenerational persistence in height using the specification described in section VI.A. We show both the OLS and Tobit estimations, where data used in the Tobit model are corrected for censorship. For each estimation method we show three specifications, each with more control variables with the purpose of verifying the robustness of the persistence estimator.

The first specification controls for the gender and age of both the young adult and the provider (column 1). The second specification models the existing correlation between the provider's height and the place of residence, by additionally controlling for the degree of *marginalization* (poverty) in the village of residence in 1995, the type of village in 1995, and an indicator of whether the household was treated in the original 1997-2000 evaluation (column 2). Finally, the third specification tests the existence of differences in height in individuals belonging to two groups of interest: the population speaking an indigenous language and the population that migrated from their villages of origin (column 3).

Table 1. Intergenerational mobility in height among the rural population of PROSPERA

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| VARIABLES | OLS | Tobit | OLS | Tobit | OLS | Tobit |
| ln provider's height (ρ) | 0.483*** | 0.484*** | 0.422*** | 0.423*** | 0.411*** | 0.411*** |
| | (0.015) | (0.016) | (0.015) | (0.016) | (0.015) | (0.016) |
| Speaks indigenous language | | | | | -0.010*** | -0.010*** |
| | | | | | (0.002) | (0.002) |
| Migrant | | | | | 0 | -0.003* |
| | | | | | (0.001) | (0.001) |
| Constant | 2.656*** | 2.696*** | 2.956*** | 3.007*** | 3.017*** | 3.065*** |
| | (0.078) | (0.084) | (0.076) | (0.081) | (0.076) | (0.081) |
| Adjusted R squared | 0.566 | | 0.584 | | 0.589 | |
| Observations | 4,385 | | 4,161 | | 4,161 | |

Notes: *(1)*= Estimations controlling by the young adult's age and gender variables; provider's age, gender and schooling. *(2)*= in addition to the variables of (1), state of residence from the ENCEL, *marginalization* (poverty) index in 1995 of the villages in the sample, and identification of the control or treatment village of the experimental evaluation of 1997-2000. (3)= in addition to the variables in (2), speaking and indigenous language and migrant. OLS= Ordinary least squares. Clustered standard errors in parentheses. Level of significance *** $p$<0.01, ** $p$<0.05, * $p$<0.1. Source: estimations performed based on data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the ENCEL panel 1997-2000.

The persistence coefficients (in provider's height) are consistent, regardless of whether OLS is used or the Tobit models, corrected for censorship, are used. However, we observe that controlling for migration and indigenous background improves precision and thus statistical significance (model 2). The estimation that controls for state of residence and migration / indigenous background modifies the persistence coefficient. That is, controlling for the effects of the context increases the mobility potential, which we estimate as 58%. This coefficient is similar to the magnitude order observed for the case of the United States in a similar study (Akbulut-Yuksel and Kugler, 2016).

Indigenous background and migration are associated with lower height, although this does not significantly affect the estimate of persistence (Table 1, Column 3, Tobit estimations). Thus, it is expected that the mobility potential in height for these groups is of similar magnitude to the rest of the population.

In contrast to the educational mobility analysis, when analyzing health outcomes such as height, the persistence coefficient reflects both intergenerational mobility, and genetic and epigenetic components. In this case it is essential to incorporate in the analysis the kinship of the analyzed individuals with the individual identified as their provider in our data. When we restrict the sample to individuals, whose providers are their biological father or mother, the persistence coefficient increases slightly to 0.44. On the contrary, if the provider is not the father or the mother, the persistence coefficient decreases to 0.33 (estimations not shown). For the purposes of this analysis we interpret the difference in estimated mobility between these two samples, 0.11, as an approximation of the effect size attributable to genetics and heritable epigenetics.

For purposes of the analysis we use the full sample, considering both the cases where the individual and provider are and are not genetically related. We do this for several reasons: it preserves sample size and improves statistical power when performing subgroup analysis, and it maintains comparability in the health and education indicators, as both then use the same sample.

Table 2 reports the estimations of mobility in terms of schooling. As expected, the level of persistence estimated here is lower than the level of persistence estimated for health (height), due to the latter including the genetic component. In line with this is our finding that the estimation for the sample where the providers are the father or mother is not different from when they are other types of providers.

In this case we find a small difference in coefficients on persistence when we correct for censorship (e.g. comparing OLS to Tobit models). Similar to the height model, the persistence coefficient is reduced from 0.34 to 0.29 when the village level covariates are included as controls, which suggests a geographical effect on the potential mobility, of the magnitude of 71% (Table 2, column 1, 3, Tobit estimations).

As presented in the program's theory of change, we expect that the accumulation of capital in the health and education dimensions follows a pattern of joint determination. To model this correlation, Table 4 presents the estimation of intergenerational mobility simultaneously for height and schooling using rank-rank models. The results are largely consistent with the results reported in the individual position models (Table 3), with a slight increase in the mobility potential in health when the effect of educational mobility is jointly considered in its determination. Here, we estimate that the potential mobility in health is 68%, while in education it is estimated as 78%.

Table 2. Intergenerational mobility in years of schooling among the rural population of PROSPERA

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| VARIABLES | OLS | Tobit | OLS | Tobit | OLS | Tobit |
| Provider's years of schooling | 0.332***<br>(0.024) | 0.343***<br>(0.025) | 0.287***<br>(0.023) | 0.297***<br>(0.024) | 0.282***<br>(0.023) | 0.292***<br>(0.023) |
| Migrant | | | | | 0.666***<br>(0.113) | 0.679***<br>(0.117) |
| Speaks indigenous language | | | | | 0.332*<br>(0.177) | 0.338*<br>(0.184) |
| Constant | 10.108***<br>(0.419) | 10.294***<br>(0.437) | 9.547***<br>(0.536) | 9.746***<br>(0.559) | 9.403***<br>(0.524) | 9.599***<br>(0.546) |
| Adjusted R square | 0.15 | | 0.186 | | 0.194 | |
| Observations | 4,425 | | 4,423 | | 4,423 | |

Notes: *(1)*= Estimations controlling by the youth's age and gender variables; provider's age, gender and schooling. *(2)*= additional to the variables of (1), entities of the sample of ENCEL, *marginalization* (poverty) index in 1995 of the villages in the sample, and identification of the control or treatment village of the experimental evaluation of 1997-2000. *(3)*= additional variables of (2), speaking an indigenous language and migrant. OLS= Ordinary least squares. Clustered Standard errors in parentheses. Level of significance *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: estimations performed based on data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the panel of ENCEL 1997-2000.

For both the health and education indicators, the rank-rank models provide larger estimations of mobility potential than the estimations that result from directly using the level of the indicator (58% and 71%, respectively). As indicated in the methods section, the estimation of mobility with the rank-rank models are more robust because they reduce biases stemming from extreme values.

Table 3. Intergenerational mobility among the rural population of PROSPERA: change in relative position

| | (1) | (2) |
|---|---|---|
| VARIABLES | Height | Years of schooling |
| Provider's relative position (Rank) ρ | 0.354*** | 0.239*** |
| | (0.018) | (0.018) |
| Constant | 0.323*** | 0.286*** |
| | (0.012) | (0.010) |
| | | |
| Observations | 4,502 | 4,425 |
| R-squared | 0.125 | 0.066 |

Notes: Standard clustered errors in parentheses. Level of significance *** $p$<0.01, ** $p$<0.05, * $p$<0.1. Source: estimations performed based on data from the Evaluation of Rural Households Survey (ENCEL) 2017.

Table 4. Intergenerational mobility height and schooling estimated simultaneously

| | (1) | (2) |
|---|---|---|
| VARIABLES | Height | Education |
| Provider's height | 0.317*** | |
| | (0.016) | |
| Provider´s education | | 0.221*** |
| | | (0.015) |
| Individual's education | 0.298*** | |
| | (0.061) | |
| Individual's height | | 0.161*** |
| | | (0.044) |
| Constant | 0.230*** | 0.211*** |
| | (0.023) | (0.021) |
| | | |
| Observations | 4,093 | 4,093 |
| Adjusted R-squared | 0.114 | 0.084 |

Notes: Controlling by level of schooling in the estimation of height, and by height in the estimation of schooling. Standard clustered errors in parentheses. Level of significance *** $p$<0.01, ** $p$<0.05, * $p$<0.1. Source: estimations performed with data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the ENCEL panel 1997-2000.

The potential mobility results confirm that, although an important persistence in the determination of human capital between generations exists, a vast potential for intergenerational mobility exists among the rural population of PROSPERA. That is, independence between the result observed for youth and the result observed for providers implies that such results are modifiable depending on external factors, and that they are not entirely genetically predetermined.

*B. Effects of PROSPERA: What is the contribution of PROSPERA to the health and education of the population who received the intervention during critical development moments?*

We expect that absolute intergenerational mobility is positive, reflecting an upward movement associated with greater welfare for younger generations, and that such mobility is of greater magnitude when the exposure to the program is higher in critical periods for development. Table

5 shows the absolute mobility in height (cm) by comparing the value of the mobility indicator between youth and providers of the same gender, in the total population, and for each of the three exposure groups (groups 1-3). Group 0 is the comparison group. Mobility in the total population is estimated as 2.83 cm for males on average, and 4.05 cm for females on average. The absolute intergenerational mobility in years of schooling is 5.2 and 5.4 for males and females, respectively (Table 6).

Table 5. Mean of absolute intergenerational mobility in health by gender and analysis group

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | Total | Group 0 | Group 1 | Group 2 | Group 3 |
| Males | 2.83 | 1.22 | 2.92*** | 3.33*** | 2.63** |
| | (0.18) | (0.45) | (0.39) | (0.27) | (0.37) |
| Females | 4.05 | 2.25 | 4.95*** | 4.32*** | 4.05** |
| | (0.25) | (0.61) | (0.66) | (0.36) | (0.48) |
| Observations | 2,199 | 288 | 401 | 1,035 | 509 |

Notes: The units are cm of height. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate statistical significance comparing the mean of each group to the mean of the reference group, group 0. Source: estimations based on ENCEL 2017.

Table 6. Mean of absolute intergenerational mobility in education, by gender and analysis group

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | All | Group 0 | Group 1 | Group 2 | Group 3 |
| Males | 5.20 | 4.05 | 5.43*** | 5.26*** | 5.56*** |
| | (0.10) | (0.20) | (0.19) | (0.14) | (0.17) |
| Females | 5.40 | 4.00 | 5.52*** | 5.69*** | 5.44*** |
| | (0.09) | (0.22) | (0.20) | (0.13) | (0.16) |
| Observations | 3,816 | 432 | 685 | 1,819 | 880 |

Notes: The units are years of schooling. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate statistical significance comparing the mean of each group to the mean of the reference group, group 0. Source: estimations based on ENCEL 2017.

In order for the comparison of absolute intergenerational mobility of individuals whose households received transfers during critical periods for development with the proposed control group to be valid, the two groups must be comparable in the pre-treatment period. To ensure this comparability, the matching analysis described in the methods section was carried out. Validation of the matching results is included in Appendix C.

Table 7 presents the comparison of each exposure group with the control group. The first two columns show estimates of absolute intergenerational mobility of height and years of schooling, based on the double difference estimator. This estimator summarizes the difference between the exposed group and the comparison group and the difference observed between the youth and their providers.

The change in intergenerational mobility presented by the comparison group (Group 0) can be interpreted as the average change expected among the rural population in the villages attended by PROSPERA between 1997 and 2000 for the group of individuals who did not receive the intervention during their critical human capital formation periods. The additional mobility observed in the differential exposure groups (Groups 1-3), in relation to the comparison group, is the change resulting from PROSPERA.

Table 7 shows the effects of PROSPERA in height and schooling, with an increasing gradient directly related to the time of exposure in critical periods for development. The individuals whose households started receiving transfers from PROSPERA in their early childhood present higher absolute mobility compared to those whose households received transfers later in the individual's life.

Table 7 presents aggregated estimations for the population, including males and females. The mobility gains in height attributable to PROSPERA correspond to 1.76 cm for the group with lesser exposure and 3.99 cm for the group with greater exposure in critical periods.

Table E.1 in Appendix E presents these results disaggregated by gender. The absolute mobility in height is much higher for females than for males, specifically for the group of females who were exposed to the program during early childhood, where we find an effect size of 7 cm. The gains in height are consistent with the national trend observed during the analyzed period.

The gain in weight was more than proportional for the increase in height, thus there is a sustained increase in the proportion of overweight or obese people. In order to verify the trends in the overweight and obesity indicators among groups with differential exposure to PROSPERA, an adjusted body mass index was constructed, for individuals up to age 30 years. This virtually eliminates the variability in BMI associated with the age of individuals[16]. Unfortunately, measurements of providers at ages comparable to youth during the analysis period are not available, so here it is not possible to use a double difference estimator. Instead, we compare each exposure group with the comparison group.

Table 7 shows the simple estimator of BMI, where we observe a decreasing gradient, with a lower BMI on average for the group of individuals with greater exposure to PROSPERA in the critical periods for growth. The reduction in BMI as an effect of PROSPERA implies that the gains in height more than compensated by the national trend in weight gain. That is, as shown in Table B.1, the relevant differences are in the height, not in the weight of the persons. By gender, the reduction in the BMI is slightly larger for females.

[16] For such purposes, it was estimated by linear regression the relation between BMI (as dependent variable), age and gender. Based on the coefficients of age and gender, the value of the BMI was calculated for each person at 30 years of age.

Table 7. Contribution of PROSPERA in height and schooling, and in other relevant variables by time of exposure

| | (1) | (2) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| VARIABLES | Mobility height | Mobility education | BMI | Cognitive score | Memory score |
| Group 1 vs Group 0 | 3.991*** | 3.728*** | -7.008*** | 1.379*** | 0.751*** |
| | (0.616) | (0.396) | (0.541) | (0.195) | (0.162) |
| Observations | 589 | 1,168 | 1,121 | 1,128 | 1,172 |
| Group 2 vs Group 0 | 3.548*** | 3.022*** | -5.093*** | 1.295*** | 0.690*** |
| | (0.572) | (0.284) | (0.316) | (0.186) | (0.136) |
| Observations | 1,114 | 2,378 | 2,294 | 2,292 | 2,382 |
| Group 3 vs Group 0 | 1.762*** | 2.541*** | -2.294*** | 0.776*** | 0.532*** |
| | (0.536) | (0.268) | (0.363) | (0.187) | (0.127) |
| Observations | 673 | 1,428 | 1,382 | 1,373 | 1,431 |
| Group 1,2 and 3 vs Group 0 | 3.093*** | 2.953*** | -4.642*** | 1.066*** | 0.624*** |
| | (0.465) | (0.279) | (0.325) | (0.165) | (0.161) |
| Observations | 1,882 | 3,999 | 3,850 | 3,866 | 4,004 |

Notes: The estimations are contrasts between the matching differences of the indicator between the group of exposure and the comparison group. Variables for matching: ln of the provider's height, eligibility score of PROSPERA in 1997 (linear and square), classification as poor household in 1997, youth's gender, provider's gender, provider's age (linear and square), provider's education, in 1997, two-months period when the transfers of PROSPERA were first received in the household of origin, number of persons in the household in 1997, and labor income of the household in 1997. Standard errors in parentheses. Level of significance *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: estimations by propensity score matching based on data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the panel of ENCEL 1997-2000.

Absolute mobility in schooling is translated into 2.5 additional years on average for the group with lower exposure to PROSPERA and 3.7 additional years on average for youth who started receiving the program during early childhood, in comparison with the group that started receiving the program when they were no longer in critical periods for growth and development. For this outcome differences in gender are not as pronounced as in the case of height.

As a complement to the absolute mobility estimators in schooling, we estimated the simple differences in scores on the cognitive and memory test performed in ENCEL 2017. We do this because we do not have information about the provider from when the youth were 14 years of age.

These results show the same logic of the gradient associated with exposure to PROSPERA; consistent with the results observed for education and height. Here, the gains in both scores are slightly higher for males than for females (Appendix E). These results suggest that the gains in years of schooling are accompanied by gains in cognitive performance, although the latter cannot be measured in an intergenerational manner, due to limitations of the data.

The analysis by sub-population does not have a sufficient number of observations, resulting in a lack of common support in the matching estimator. For this reason, we present the estimation for the group of individuals who speak an indigenous language, without differentiating by gender. Table 8 shows that for the population who speaks an indigenous language the mobility gains in height are relatively lower than those estimated for the total of the population. This occurs in spite of the fact that the mobility potential we estimated in section VII.A was similar to that of the total population. In terms of mobility in schooling, the gains are greater among the population speaking an indigenous language, but the estimators for the cognitive and memory development present lower levels than the total population. Reductions in BMI are also of a lower magnitude than those in the general population, but still significant.

Table 9 shows the estimation based on the original evaluation design. That is, estimating the effect of the intervention comparing individuals from households in original treatment and control villages, limited to the set of households that were classified as poor in 1997. This comparison measures an exposure differential of approximately 18 months; the average time between when the intervention began, until when control villages received the program at the end of 1999.

Even with this differential exposure of only 18 months, the short and mid-term evaluations identified positive effects of PROSPERA on the height indicator in children under 5 years of age. It is especially relevant to analyze the possible long-term effect of the program on height using the original evaluation design for groups with exposure during the critical periods for the development, in order to identify whether these effects persist in the long term.

In addition, for the set of the three groups with exposure in critical periods for growth, we identified an effect on height of 2.93 cm. This is consistent with, and of similar magnitude to, the estimated effect using as the comparison group the population that was 15 years of age or older in 1997, who did not receive the intervention during their critical periods for development.

Table 8. Contribution of PROSPERA to height and schooling, and to other relevant variables by time of exposure of populations that speak an indigenous language.

| | (1) | (2) | (4) | (7) | (8) |
|---|---|---|---|---|---|
| VARIABLES | Mobility height | Mobility education | BMI | Cognitive score | Memory score |
| Group 1 vs Group 0 | 2.327*** | 4.593*** | -5.300*** | 0.766** | 0.987*** |
| | (0.742) | (0.377) | (0.866) | (0.337) | (0.148) |
| Observations | 169 | 312 | 303 | 299 | 314 |
| Group 2 vs Group 0 | 2.834*** | 4.542*** | -4.382*** | 0.528* | 0.865*** |
| | (0.994) | (0.692) | (0.797) | (0.295) | (0.152) |
| Observations | 292 | 607 | 591 | 587 | 609 |
| Group 3 vs Group 0 | 1.233 | 2.440*** | -1.662*** | 0.558** | 0.587*** |
| | (0.923) | (0.377) | (0.568) | (0.267) | (0.168) |
| Observations | 197 | 401 | 394 | 380 | 403 |
| Group 1,2 and 3 | 3.324*** | 4.298*** | -4.601*** | 0.683** | 0.930*** |
| vs Group 0 | (0.519) | (0.443) | (1.103) | (0.278) | (0.168) |
| Observations | 510 | 1,045 | 1,020 | 1,007 | 1,047 |

Notes: The estimations are contrasts between the matching differences of the indicator between the group of exposure and the comparison group. Variables for matching: ln of the provider's height, eligibility score of PROSPERA in 1997 (linear and square), classification as poor household in 1997, gender, provider's gender, provider's age (linear and square), provider's education, in 1997, two-months period when the transfers of PROSPERA were first received in the household of origin, number of persons in the household in 1997, and labor income of the household in 1997. Standard errors in parentheses. Level of significance *** $p$<0.01, ** $p$<0.05, * $p$<0.1. Source: estimations by propensity score matching based on data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the panel of ENCEL 1997-2000.

We find that the estimated positive effect of PROSPERA is driven by the groups in treatment villages who received the intervention in critical periods for building human capital. No effects were found in the group that had passed the critical periods of growth (Group 0, youth over 15 years of age in 1997).

Using the original PROSPERA experimental design, an impact of 1.5 years in education for the inhabitants of the treatment villages was found and this result is statistically significant at the 10% level, consistent with the literature. When the sample is separated by age groups, this result loses statistical power, but is positive in all cases. Results for BMI and cognitive and memory scores are not robust to the different specifications used in this exercise and, in general, are not statically significant.

As a whole, these results indicate that PROSPERA improved the accumulation of human capital among the rural population that received the program.

Table 9. Estimation of the effect of PROSPERA considering the original evaluation design (1997-2000)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | Mobility height | Mobility education | BMI | Cognitive score | Memory score |
| Treatment vs Control | 1.452* | 1.570* | 0.481 | -0.898* | -0.340* |
| | (0.771) | (0.862) | (0.612) | (0.501) | (0.176) |
| Observations | 1,337 | 2,850 | 2,741 | 2,756 | 2,852 |
| Treatment vs Control, group 0 | -0.182 | 0.359 | 1.318** | -0.074 | 0.052 |
| | (0.851) | (0.696) | (0.599) | (0.333) | (0.226) |
| Observations | 116 | 238 | 228 | 224 | 239 |
| Treatment vs Control, group 1, 2 and 3 | 2.938** | 0.683 | -0.866 | -0.447 | 0.025 |
| | (1.387) | (1.029) | (1.152) | (0.410) | (0.217) |
| Observations | 1,205 | 2,580 | 2,482 | 2,500 | 2,581 |

Notes: The estimations are contrasts between the matching differences of the indicator between the group of exposure and the comparison group. Variables for matching: in the provider's height, eligibility score of PROSPERA in 1997 (linear and square), classification as poor household in 1997, gender, provider's gender, provider's age (linear and square), provider's education, in 1997, two-months period when the transfers of PROSPERA were first received in the household of origin, number of persons in the household in 1997, and labor income of the household in 1997. Standard errors in parentheses. Level of significance *** $p$<0.01, ** $p$<0.05, * $p$<0.1. Source: estimations by propensity score matching based on data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the panel of ENCEL 1997-2000.

*C. Returns to human capital: Intergenerational mobility and what is the effect of improvements in health and education on labor income?*

The translation of the estimated intergenerational mobility in height and schooling into social mobility is approximated by the returns in height and schooling on individuals' labor income. Table 10 shows the returns model with estimations separated by gender based on the Heckman model. Columns 1 and 3 show that an increase of 1% in height is associated with higher labor income: 10.73% for males and 8.76% for females. We also find that a one-year increase in schooling is associated with 3.4% more labor income for males and 4.8% more labor income for females. This analysis does not consider potential non-linear returns to schooling.

In comparison to the literature on height and income, the height coefficient we estimate is higher than expected for the complete national income distribution in Mexico (see, for example, Vogl 2014). Our estimate is similar, however, to the estimates for the population in the lower part of the distribution, with levels of 8% and 11%, in studies like those from Lundborg *et al.* 2009, Case and Paxon 2008 and Persico *et al*. 2004. In addition to finding coefficients of similar magnitude to ours for the lower part of the income distribution, these authors find that the effect on income is greater for the population with lower height, which is also the population living in greater conditions of poverty. Furthermore, the authors state that this coefficient captures the effect of the parent's variables of origin and, specifically, Case and Paxon note that the magnitude is associated with a higher correlation with the increase in cognitive abilities accompanied by the additional growth in height, so that to the extent that these factors are controlled, the coefficient may be substantially reduced in magnitude.

Considering the gains in intergenerational mobility of height and schooling of PROSPERA that we reported on the previous section, a male individual with greater exposure to the program (Group 1) would receive a 9.4% higher average income due to the mobility in height and 12.0% increase in schooling in comparison with those who were not exposed to PROSPERA in critical periods. For females, the increases would be 17.1% and 17.8%, respectively.[17] Thus, the total returns on labor income are composed of both the accumulation of health and of educational capital.

This result translated into pesos implies a base hourly wage of 14.73 pesos for the males in the comparison group, which would increase to 18.84 pesos for the group with the highest exposure to PROSPERA. For women, the estimated base hourly wage is 12.68 in the comparison group, which would increase to 20.18 pesos in the group with the highest exposure to the program.[18]

The association between BMI and income results negative and significant: each additional point of BMI is associated with a reduction in labor income of 2.1% for males and 3.1% for females. The sign of the coefficient is as expected because, as previously mentioned, overweight and obesity consume health capital which is in this case reflected in the expected returns.

Controlling for accumulated capital, measured by height and years of schooling, and for the context variables that determine labor participation, no statistically significant differences are observed in the expected income for indigenous persons.

Other results, consistent with the results of the mid-term evaluation, indicate that individuals who migrated from their villages of origin have on average higher incomes: 47.3% higher for males and 20.3% for females, in comparison to those who remained in their villages of origin. We have no data on the population that migrated to the United States or to parts of Mexico other than major cities. Thus, this estimate reflects only the migration to places captured in the ENCEL 2017 data. We thus expect this estimate to underestimate the effect of migrating on income, as those who migrate to the United States likely have the highest income and are excluded from this analysis.

Despite this, the estimator reflects that the return to accumulated capital in health and education can be enhanced in presumably more favorable contexts, that is, those with less *marginalization* (poverty) and isolation than the villages of origin. This same logic is reflected in the estimations of the selection model (columns 2 and 4), where having migrated from one's place of origin reflects a greater probability of entering the labor market, especially for females.

[17] The mobility in additional height for male individuals of the group with greater exposure in critical periods is of 2.4 cm. In an equivalent manner, the mobility in additional years of schooling is 3.53 years. For females the calculation is equivalent.

[18] This considers the average income of the population and adds the average gains by height and schooling. Pesos reported in the collection period of ENCEL 2017.

Table 10. Human capital returns measured by height and schooling among the rural population of PROSPERA

| | Males | | Females | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | ln(w) | Works[a)] | ln(w) | Works |
| **ln of Height in cm (predicted)** | **10.736***<br>(2.152)** | **9.708***<br>(2.923)** | **8.764***<br>(2.660)** | **2.527<br>(2.380)** |
| **Schooling (years)** | **0.034***<br>(0.007)** | **-0.026<br>(0.016)** | **0.048***<br>(0.010)** | **0.024**<br>(0.010)** |
| BMI | -0.021**<br>(0.008) | -0.020*<br>(0.012) | -0.031***<br>(0.012) | 0.004<br>(0.010) |
| Age | 0.018***<br>(0.004) | 0.029***<br>(0.009) | 0.019***<br>(0.006) | 0.022***<br>(0.006) |
| Speaks indigenous language | -0.053<br>(0.063) | | -0.042<br>(0.093) | |
| Migrated = 1 | 0.473***<br>(0.047) | 0.325**<br>(0.144) | 0.203***<br>(0.066) | 0.446***<br>(0.072) |
| Household with children from 0 to 5 years of age | | 0.223<br>(0.141) | | -0.190***<br>(0.065) |
| Has a partner | | -0.346<br>(0.338) | | -0.772***<br>(0.179) |
| Lives with the partner | | 0.622*<br>(0.344) | | -0.132<br>(0.176) |
| ln Income in the household[b)] | | -0.049***<br>(0.013) | | -0.061***<br>(0.010) |
| Constant | -52.349***<br>(10.900) | -48.051***<br>(14.790) | -41.515***<br>(13.270) | -13.010<br>(11.848) |
| Observations | 1,992 | | 2,358 | |

Note: a) To estimate the selection equation, the following variable were added to the Mincer model: Household with children from 0 to 5 years of age; has a partner/spouse; lives with the romantic partner; and ln of the monthly income of the household. b) Corresponds to the monthly income of the household deducting the monthly income of the index young adult. /athrho of 0.046 and standard error of (0.054) for males; -0.068 and (0.089) for females. /lnsigma of -0.176***and standard error of (0.031) for males; -0.091**and (0.040) for females. Standard errors in parentheses. Level of significance *** $p$<0.01, ** $p$<0.05, * $p$<0.1. Source: estimations performed based on the data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the panel of ENCEL 1997-2000

In summary, the results of the Mincer model of human capital returns indicate that for the population raised in rural households with maximum exposure to PROSPERA, there is a premium in terms of labor income, the result of the gains in height and schooling. We also observe that the population with the highest levels of education earns the highest labor income, on average.

## VIII. Conclusions

This study focused on the analysis of the data collected as part of the Evaluation of Rural Households Survey 2017 (ENCEL 2017) and on the previous rounds of ENCEL and ENCASEH 1997. In particular, we use 1997-2000 as the baseline period in order to investigate the potential for intergenerational mobility, and the magnitude of the absolute intergenerational mobility of human capital (height as measurement of health and schooling as measurement of education), among the population that comprised the first phase of incorporation to PROSPERA 20 years ago. Furthermore, we estimate the returns in labor income to improvements in health and education that are attributable to PROSPERA.

The analysis enables us to show that in the rural Mexican households in villages where PROSPERA began, there is a relatively high level of intergenerational mobility in health and education. This population presents important absolute mobility in health (height) and education (years of schooling), that is larger among youth with greater exposure to PROSPERA, for whom increases in height and years of schooling are greater than expected, after accounting for secular trends in the country. These increases in height and schooling reflect improvements accumulated during critical growth and development periods attributable to several factors that have been well documented in the short and mid-term evaluations, such as: improvements in nutrition, reduction in infant mortality, increases in the use of health services, and continued enrollment in school.

Our results indicate that the potential for intergenerational mobility is greater in education than in health, which may be due to genetic and epigenetic factors having greater relative importance as determinants of height (our indicator for human health capital) than as determinants of education. Despite this, the potential mobility of both human capital indicators is large, that is, there is a margin for improving health and education of this population that is not fully determined by inheritance. These improvements may only be achieved through targeted policies promoting the creation of better environmental and contextual conditions, and the creation of economic opportunities (jobs) for the population, specifically those living in poverty.

Beyond the effects on the indicators of health and education capital accumulation, we estimated that the intergenerational mobility in these dimensions is translated into labour market returns. The fact that both height and schooling promote intergenerational social mobility highlights PROSPERA's potential to improve population outcomes, especially when individuals receive the transfers during critical periods of growth and development. Thus, we find that the population with greater early exposure to PROSPERA has higher human capital and higher labor income after 20 years.

It is important to note that these outcomes have occurred during a time of changing population health in Mexico, marked by a large increase in the prevalence of non-communicable diseases in the adult population. This change in population health is related to the overweight and obesity epidemic that continues to affect the entire population, and which began at approximately the same time as PROSPERA. This epidemic especially affects low-income populations. The analyses conducted in this paper show that, although the services promoted by the program are insufficient to revert the observed increase in the overweight and obesity indicators, PROSPERA has contributed to reducing such an increase. This is related to the increase in height: with a constant weight, greater height is reflected in lower BMI.

The analysis performed here has some important limitations, the most notable being the limited data available in ENCEL 2017. In this round of the survey, an important set of men and women from the households that received PROSPERA in its initial phases were interviewed. However, the survey does not include the individuals who have migrated outside of Mexico and those who have migrated elsewhere in the country. ENCEL 2017 includes only individuals who did not migrate, or those who migrated within the same seven states of the original panel, and only to certain large cities within those states. The results of the previous evaluations indicate that it is reasonable to expect that the average conditions of those who migrated outside Mexico are, in general, better than the conditions of those who remained. This means that the results presented here may reflect an underestimation of the effects of PROSPERA.

Furthermore, for some important variables, there was no information available on the providers when the youth were 14 years old, which we would have used to measure intergenerational mobility. However, it was possible to estimate the maximum height of the providers using known information - current height and age - adjusted based on the information on height loss reported in the literature.

These results indicate that PROSPERA has achieved effects on health, education and labor income indicators that are consistent with the proposed theory of change. These results could be even greater if there were improvements in the general health and economic well-being of the population. From the public health perspective, a relevant challenge is to understand the ongoing overweight and obesity epidemic: by consuming health capital, this epidemic works counter to PROSPERA´s goal, reducing the possibility of PROSPERA improving social mobility. As shown in the results, overweight is associated with a reduction in individuals' income on average, thus reducing their capacity for social mobility.

An additional challenge not analyzed in this paper, but that has been extensively documented, is the need to improve of the quality of the services provided to the population. Evidence indicates that current health services for the population of PROSPERA are of limited quality. The challenge in the quality of health services delivery is not limited to the population of PROSPERA, but is an issue affecting the Mexican population in general.

The intervention analyzed here—that is, one based on incentivizing demand for health and educational services through conditional cash transfers that work to promote the accumulation of human capital and social mobility—showed overall positive results. This intervention could be strengthened by specific actions focused on vulnerable groups, such as the indigenous population, and by generating mechanisms to improve the quality of health and educational services in Mexico.

To the best of our knowledge, this is the first analysis of intergenerational mobility of health in Mexico, and that is based on both anthropometric measurements and information provided directly by individuals from all analyzed generations. A strength of this study is that the analysis uses longitudinal data.

Finally, improving human capital will not suffice to interrupt the intergenerational transmission of poverty in a severely constrained economic context. For example, it helps neither the students nor the economy to train a large cohort of engineers if there are no jobs for new engineers. The improvement in intergenerational mobility, as proposed in the theory of change, rests on assumptions. These assumptions include: the existence of high-quality health and educational services, an economy capable of generating employment opportunities, and equal access to the labor market. With these institutions in place, the improvement in health and human capital estimated here may improve the lives of future generations.

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## Appendices

### *Appendix A*

Table A.1 Variables of interest

| Indicator | Comments | Source |
|---|---|---|
| **Mobility in health and education** | | |
| The maximum height achieved in cm in 2017, both for youth and for providers. | For the providers the maximum height was estimated based on the height at the time of the survey and the age in accordance with the equation proposed by Cline *et al*. | ENCEL 2017. |
| Age at birth of first child and age at first pregnancy. | For mobility, only women were considered because no information on male providers was available. For the analysis of the effects the entire group is considered (males and females). | ENCEL 2017 for youth, ENCASEH 1997 and ENCEL 1998 to 2000 for providers. |
| Years of schooling completed in 2017 for youth and reported between 1997-2000 for providers. Furthermore, the years of schooling for youth between 1997-2000 are available. | Only for providers who were part of the households between 1997-2000. Excluded are providers who appear in subsequent rounds, or who were not part of the original household (for example, spouse in the event of early marriages). | ENCEL 2017 for youth, ENCASEH 1997 and ENCEL 1998 to 2000 for providers. |
| Cognitive ability measured with fluid intelligence using Raven's matrices.[19] | No previous measurement of the providers is available; therefore, it is not possible to identify cognitive ability mobility. | ENCEL 2017. |
| Memory tests.[20] | No previous measurement of the providers is available; therefore, it is not possible to identify the memory test mobility. | ENCEL 2017. |

[19] Raven's progressive matrices is a non-verbal cognitive test that measures abstract reasoning. This test is most commonly applied to subjects 5 years of age or older to measure fluid intelligence, that is, the capacity to extract correlates based on two or more informative elements, which is evaluated through abstract analogies in which data neither become obsolete nor are from a specific culture. (Raven J.C., Court J.H., Raven Test- Progressive Matrices. Pearson Clinical).

[20] ENCEL 2017 included two questions to measure short-term memory capacity and labor memory, which results essential for verbal comprehension and problem solving suddenly presented (Ostrosky-Solís, F. y Lozano, A. (2006). Digit span: Effect of education and culture. International Journal of Psychology, 41(5), 333-41).

| Indicator | Comments | Source |
|---|---|---|
| Report of having consumed alcohol, tobacco and marihuana | | ENCEL 2017. |
| Age of initiating consumption of tobacco and alcohol for youth and providers. | | ENCEL 2017. |
| Labor participation (provider and youth) | Report on labor activities | ENCEL 2017 |
| Labor income per day, considering the amount of labor and number of days reported in the same month | Only the person with labor participation, this is, those who report a productive activity | ENCEL 2017 |
| **Conditions that affect accumulation** | | |
| Tobacco, alcohol, and marijuana consumption | For marijuana the report of ever consuming marijuana was considered. For tobacco and alcohol, the report of the age of first consumption is considered. | ENCEL 2017 |
| Participation in antisocial behaviors | Report on ever having stolen or destroyed a third party's property | ENCEL 2017 |
| Overweight and obesity | Body mass index ($kg/m^2$) | ENCEL 2017 |
| **Characteristics of the original household** | | |
| Bi-monthly period when the transfers initiated | | Administrative data in panel base ENCEL 2017 |
| Total amount of transfers to original household | | Panel base ENCEL 2017 |
| Original eligibility qualification | | Panel base ENCEL 2017 |
| Type of village in the original experiment (control or baseline) between 1997 and 2000 | | Panel base ENCEL 2017 |
| **Additional individual characteristics** | | |
| Speaks an indigenous language | Used both for stratification and as a variable in the selection equation | ENCEL 2017 |
| Provider with disability | | ENCEL 2017 |

## *Appendix B*

Table B.1 Youth in ENCEL 2017, by gender and exposure groups

| Variable | Gender | Total | G0 | G1 | G2 | G3 |
|---|---|---|---|---|---|---|
| Age | Males | 27.80 | 41.49 | 20.34*** | 25.14*** | 31.23*** |

| Variable | Gender | Total | G0 | G1 | G2 | G3 |
|---|---|---|---|---|---|---|
| | | (0.15) | (0.27) | (0.03) | (0.05) | (0.09) |
| | Females | 27.94 | 40.82 | 20.44*** | 25.21*** | 31.37*** |
| | | (0.13) | (0.26) | (0.03) | (0.04) | (0.08) |
| Height (cm) | Males | 164.22 | 161.62 | 165.22*** | 164.58*** | 164.15*** |
| | | (0.24) | (0.47) | (0.42) | (0.28) | (0.34) |
| | Females | 152.62 | 150.37 | 153.54*** | 153.32*** | 151.84*** |
| | | (0.21) | (0.45) | (0.37) | (0.23) | (0.29) |
| Weight (kg) | Males | 70.51 | 71.83 | 68.05*** | 70.35 | 71.98 |
| | | (0.40) | (0.95) | (0.79) | (0.49) | (0.60) |
| | Females | 62.41 | 65.54 | 58.15*** | 61.61*** | 64.79 |
| | | (0.37) | (0.82) | (0.78) | (0.48) | (0.63) |
| Body mass index | Males | 26.02 | 27.41 | 24.59*** | 25.86*** | 26.66** |
| | | (0.11) | (0.29) | (0.22) | (0.15) | (0.19) |
| | Females | 26.46 | 28.72 | 24.25*** | 25.89*** | 27.72*** |
| | | (0.11) | (0.28) | (0.23) | (0.14) | (0.21) |
| Cognitive test score | Males | 4.26 | 3.32 | 4.84*** | 4.43*** | 4.00*** |
| | | (0.07) | (0.16) | (0.12) | (0.08) | (0.12) |
| | Females | 4.14 | 3.11 | 4.70*** | 4.35*** | 3.90*** |
| | | (0.06) | (0.14) | (0.13) | (0.08) | (0.10) |
| Memory test score | Males | 3.39 | 2.95 | 3.61*** | 3.36*** | 3.51*** |
| | | (0.04) | (0.08) | (0.10) | (0.05) | (0.08) |
| | Females | 3.22 | 2.67 | 3.45*** | 3.31*** | 3.18*** |
| | | (0.04) | (0.10) | (0.08) | (0.05) | (0.06) |
| Years of Schooling | Males | 8.59 | 6.23 | 9.62*** | 8.93*** | 8.45*** |
| | | (0.10) | (0.20) | (0.19) | (0.13) | (0.15) |
| | Females | 8.68 | 6.56 | 9.45*** | 9.17*** | 8.32*** |
| | | (0.11) | (0.22) | (0.18) | (0.13) | (0.15) |
| Labor Participation = 1 | Males | 0.91 | 0.94 | 0.84*** | 0.92 | 0.95 |
| | | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) |
| | Females | 0.35 | 0.39 | 0.33 | 0.33* | 0.37 |
| | | (0.01) | (0.03) | (0.03) | (0.01) | (0.02) |
| Ln labor Income per hour | Males | 2.74 | 2.69 | 2.74 | 2.76 | 2.71 |
| | | (0.03) | (0.06) | (0.05) | (0.04) | (0.04) |
| | Females | 2.70 | 2.54 | 2.50 | 2.76** | 2.77** |
| | | (0.04) | (0.09) | (0.10) | (0.05) | (0.05) |
| Not insured = 1 | Males | 0.17 | 0.16 | 0.22** | 0.17 | 0.12 |
| | | (0.01) | (0.02) | (0.02) | (0.01) | (0.01) |
| | Females | 0.11 | 0.09 | 0.12 | 0.12 | 0.10 |
| | | (0.01) | (0.02) | (0.02) | (0.01) | (0.01) |
| Ever pregnant = 1 | Males | 0.55 | 0.81 | 0.23*** | 0.52*** | 0.73** |
| | | (0.01) | (0.02) | (0.02) | (0.02) | (0.02) |

| Variable | Gender | Total | G0 | G1 | G2 | G3 |
|---|---|---|---|---|---|---|
| | Females | 0.75 | 0.90 | 0.50*** | 0.73*** | 0.86 |
| | | (0.01) | (0.02) | (0.03) | (0.01) | (0.01) |
| Age at first Pregnancy | Males | 21.41 | 23.24 | 18.45*** | 20.71*** | 21.99*** |
| | | (0.12) | (0.35) | (0.15) | (0.13) | (0.18) |
| | Females | 19.53 | 20.48 | 17.80*** | 19.39*** | 19.87** |
| | | (0.08) | (0.24) | (0.13) | (0.10) | (0.17) |
| Pregnant at 19 years or Younger | Males | 0.20 | 0.19 | 0.17 | 0.19 | 0.24 |
| | | (0.01) | (0.03) | (0.02) | (0.01) | (0.02) |
| | Females | 0.42 | 0.43 | 0.39 | 0.41 | 0.46 |
| | | (0.01) | (0.03) | (0.03) | (0.01) | (0.02) |
| Age at Having first child | Males | 22.36 | 24.37 | 19.20*** | 21.59*** | 22.96*** |
| | | (0.12) | (0.35) | (0.14) | (0.13) | (0.18) |
| | Females | 20.19 | 21.19 | 18.39*** | 20.02*** | 20.53** |
| | | (0.09) | (0.24) | (0.13) | (0.09) | (0.17) |
| Had a child at 19 years or younger | Males | 0.12 | 0.11 | 0.12 | 0.12 | 0.13 |
| | | (0.01) | (0.02) | (0.02) | (0.01) | (0.02) |
| | Females | 0.35 | 0.36 | 0.33 | 0.33 | 0.39 |
| | | (0.01) | (0.03) | (0.02) | (0.01) | (0.02) |
| Has consumed alcohol = 1 | Males | 0.90 | 0.92 | 0.87** | 0.90 | 0.92 |
| | | (0.01) | (0.02) | (0.02) | (0.01) | (0.01) |
| | Females | 0.60 | 0.51 | 0.62*** | 0.63*** | 0.60*** |
| | | (0.01) | (0.03) | (0.02) | (0.02) | (0.02) |
| Has smoked = 1 | Males | 0.42 | 0.46 | 0.42 | 0.42 | 0.41 |
| | | (0.01) | (0.03) | (0.03) | (0.02) | (0.02) |
| | Females | 0.08 | 0.05 | 0.07 | 0.10*** | 0.07 |
| | | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) |
| Has smoked marijuana= 1 | Males | 0.10 | 0.08 | 0.11 | 0.11* | 0.08 |
| | | (0.01) | (0.02) | (0.02) | (0.01) | (0.01) |
| | Females | 0.01 | 0.00 | 0.02* | 0.01 | 0.00 |
| | | (0.00) | (0.00) | (0.01)* | (0.00) | (0.00) |

Notes: Measure or average with adjustment by data censorship. G0 (36 to 56 years of age) is comparison, G1 (17 to 21 years of age) high exposure, G2 (22 to 28 years of age) medium exposure, and G3 (29 to 35 years) low exposure, regarding critical periods for building human capital. Standard errors in parentheses. Significance level *p of the difference with the comparison group < 0.1; **p of the difference with the comparison group < 0.05; ***p of the difference with the comparison group < 0.05. Source: Estimations of the authors based on ENCEL 2017.

Table B.2 Characteristics of the providers in ENCEL 2017,
by provider's gender and youth's exposure groups

| Variable | Gender | Total | G0 | G1 | G2 | G3 |
|---|---|---|---|---|---|---|
| Age | Males | 58.80 | 66.78 | 52.66*** | 57.06*** | 62.38*** |
| | | (0.24) | (0.56) | (0.41) | (0.27) | (0.36) |
| | Females | 56.33 | 64.58 | 49.90*** | 54.52*** | 59.20*** |
| | | (0.40) | (0.89) | (0.73) | (0.47) | (0.64) |
| Height (cm) | Males | 161.42 | 160.03 | 162.32*** | 161.45*** | 161.43*** |
| | | (0.21) | (0.37) | (0.32) | (0.23) | (0.30) |
| | Females | 148.70 | 148.04 | 148.80 | 148.99 | 148.40 |
| | | (0.26) | (0.67) | (0.54) | (0.30) | (0.37) |
| Weight (kg) | Males | 69.45 | 65.91 | 72.55*** | 70.04*** | 67.91** |
| | | (0.43) | (0.98) | (0.69) | (0.47) | (0.61) |
| | Females | 62.08 | 61.13 | 62.72 | 62.66 | 60.94 |
| | | (0.54) | (1.48) | (1.13) | (0.60) | (0.94) |
| Body mass index | Males | 26.70 | 25.77 | 27.61*** | 26.88*** | 26.16* |
| | | (0.12) | (0.20) | (0.21) | (0.14) | (0.17) |
| | Females | 28.14 | 28.16 | 28.08 | 28.38 | 27.64 |
| | | (0.20) | (0.53) | (0.37) | (0.23) | (0.33) |
| Cognitive test score | Males | 2.95 | 2.61 | 3.04** | 3.07*** | 2.81 |
| | | (0.06) | (0.14) | (0.10) | (0.08) | (0.09) |
| | Females | 2.96 | 2.55 | 3.38** | 3.02*** | 2.78 |
| | | (0.09) | (0.20) | (0.18) | (0.12) | (0.16) |
| Memory test score | Males | 2.22 | 1.83 | 2.46*** | 2.28*** | 2.12*** |
| | | (0.04) | (0.08) | (0.07) | (0.04) | (0.05) |
| | Females | 1.85 | 1.42 | 2.07*** | 1.96*** | 1.73** |
| | | (0.06) | (0.11) | (0.11) | (0.07) | (0.10) |
| Years of schooling | Males | 3.56 | 2.40 | 4.30*** | 3.86*** | 3.04*** |
| | | (0.09) | (0.15) | (0.14) | (0.11) | (0.11) |
| | Females | 3.39 | 2.11 | 4.38*** | 3.69*** | 2.91*** |
| | | (0.15) | (0.24) | (0.28) | (0.16) | (0.23) |
| Not insured = 1 | Males | 0.07 | 0.07 | 0.09 | 0.08 | 0.06 |
| | | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| | Females | 0.04 | 0.04 | 0.03 | 0.05 | 0.05 |
| | | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) |
| Labor participation= 1 | Males | 0.87 | 0.72 | 0.93*** | 0.89*** | 0.85*** |
| | | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) |
| | Females | 0.43 | 0.33 | 0.46** | 0.46*** | 0.43** |
| | | (0.02) | (0.04) | (0.04) | (0.02) | (0.03) |

| Variable | Gender | Total | G0 | G1 | G2 | G3 |
|---|---|---|---|---|---|---|
| Speaks indigenous language =1 | Males | 0.35 | 0.38 | 0.34 | 0.35 | 0.35 |
| | | (0.03) | (0.04) | (0.03) | (0.03) | (0.03) |
| | Females | 0.31 | 0.29 | 0.31 | 0.32 | 0.32 |
| | | (0.03) | (0.05) | (0.05) | (0.03) | (0.04) |
| Presents some disability = 1 | Males | 0.05 | 0.07 | 0.05* | 0.04 | 0.06 |
| | | (0.00) | (0.01) | (0.01) | (0.01) | (0.01) |
| | Females | 0.08 | 0.13 | 0.05 | 0.06* | 0.09 |
| | | (0.01) | (0.03) | (0.02) | (0.01) | (0.02) |

Notes: Measure or average with adjustment by data censorship. G0 (36 to 56 years of age) is comparison, G1 (17 to 21 years of age) high exposure, G2 (22 to 28 years of age) medium exposure, and G3 (29 to 35 years) low exposure, regarding critical periods for building human capital. Standard errors in parentheses. Significance level *p of the difference with the comparison group < 0.1; **p of the difference with the comparison group < 0.05; ***p of the difference with the comparison group < 0.05.
Source: Estimations of the authors based on ENCEL 2017.

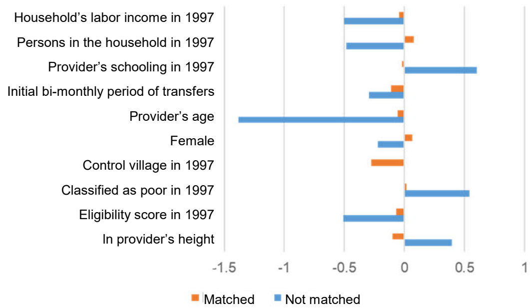
***Appendix C***

In order to support the matching analysis performed to estimate the effects of PROSPERA on intergenerational mobility and related indicators, in this appendix we present figures displaying common support and balance between the three intervention groups and the comparison groups.

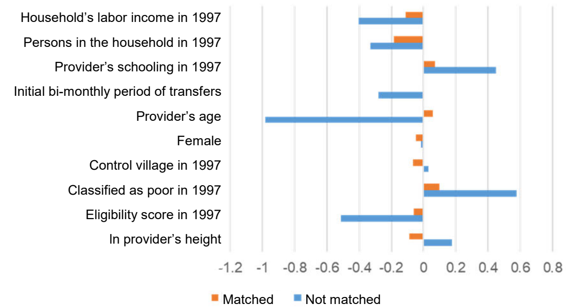
Figures C2.1 and C2.2 display mobility indicators for height and schooling, respectively, before and after propensity score matching was conducted. Figures C2.1 and C2.2 show that matching reduces the difference in the baseline values of the height and schooling mobility variables, between each analysis group and the comparison group.

Figures C2.3 and C2.4 display the distribution of propensity scores, or the probability of treatment conditional on baseline covariates, for each analysis group and for the comparison group. Once the propensity score matching is carried out, we have a region of common support; the distributions of propensity scores between the three intervention groups overlap with that of the comparison group. We note that the number of observations for mobility in height is smaller than for mobility in schooling, however, with propensity score matching we are able to achieve a similar amount of common support with the comparison group.

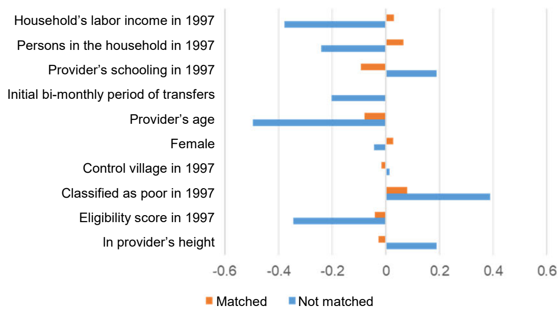
Figure C2.1. Balance pre- and post- matching for mobility in height, by set of analysis.




Group A vs Comparison



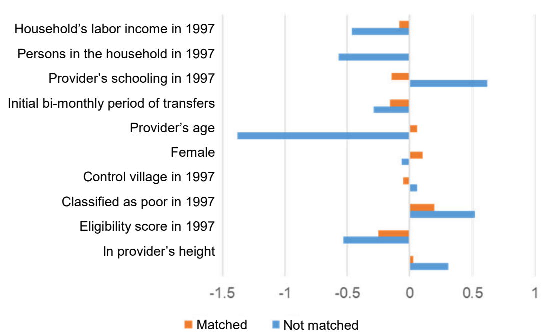

Group B vs Comparison



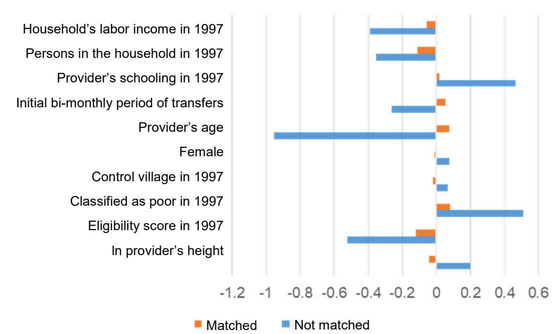

Group C vs Comparison

Source: Estimates from the authors based on data from ENCEL and ENCASEH

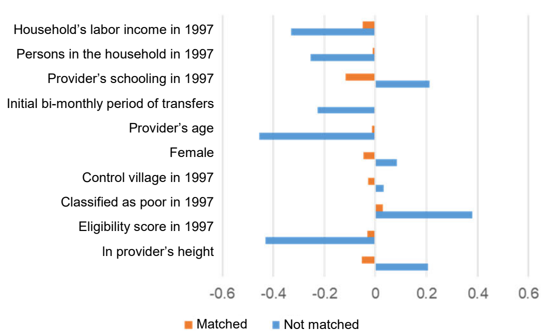
Figure C2.2. Balance pre- and post- matching for mobility in schooling, by set of analysis.




Group A vs Comparison



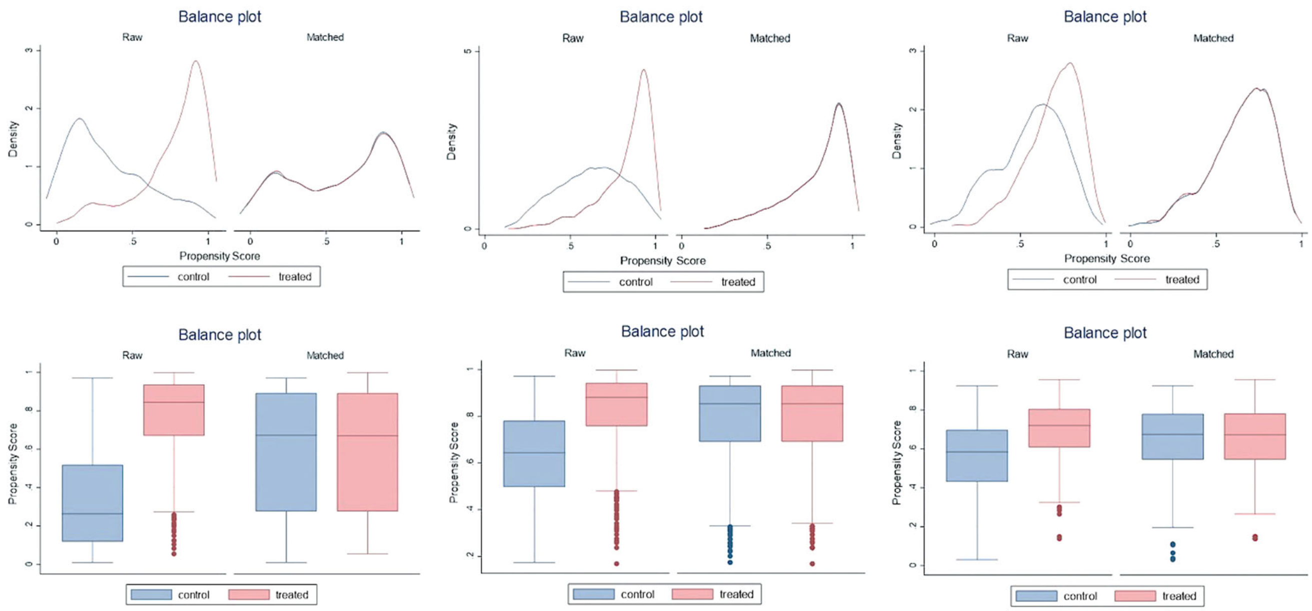

Group B vs Comparison




Group A vs Comparison

Source: Estimates from the authors based on data from ENCEL and ENCASEH

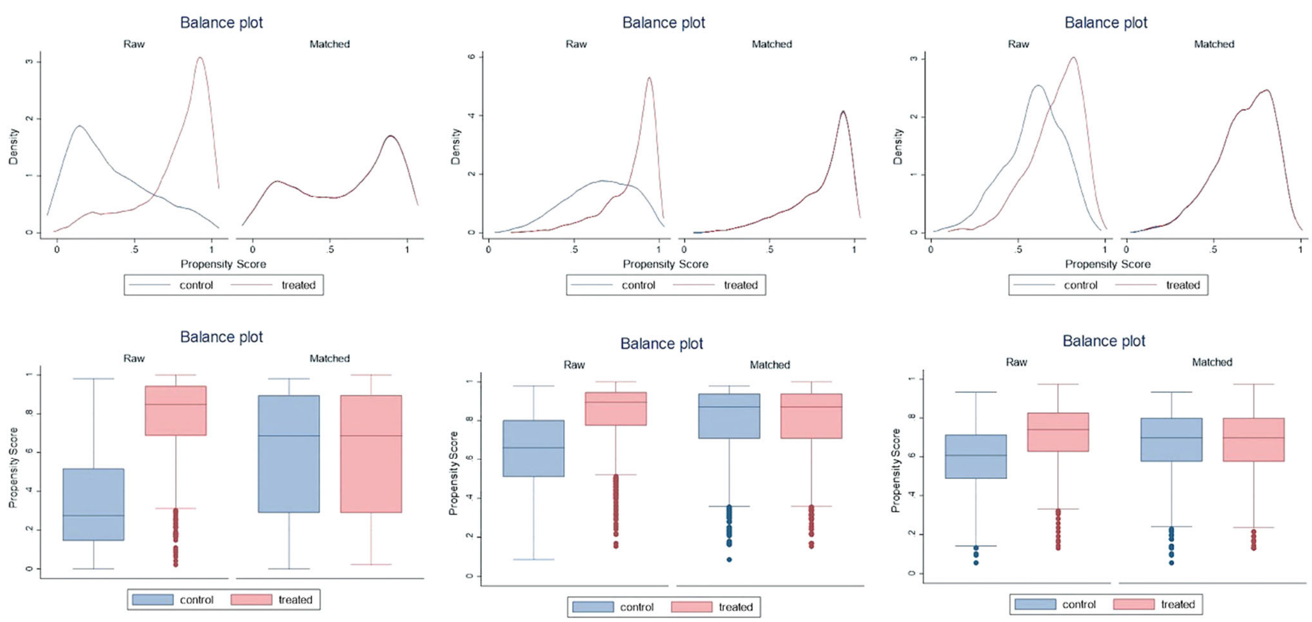
Figure C2.3. Common support and propensity score balance for mobility in height, by set of analysis.




Group A vs Comparison Group B vs Comparison Group C vs Comparison

Source: Estimations from the authors based on data from ENCEL

Figure C2.4. Common support and propensity score balance for mobility in education, by set of analysis.




Group A vs Comparison Group B vs Comparison Group C vs Comparison

Source: Estimations from the authors based on data from ENCEL

*Appendix D*

Below we describe in detail the methodology used to instrument for health. Equation (10) is the model used to instrument for $S_i$, the health indicator:

$$S_i = \alpha' K_i + \vartheta_i \tag{10}$$

Where:

$$\vartheta_i \sim N\left(0, \sigma_\vartheta^2\right) \tag{11}$$

$S_i$ is measured using the youth's height and $K_i$ is a vector of the following variables:

- *Marginalization* (poverty) index in the villages in 1995 and in 2000, both generated by Conapo based on data from the 1995 and the 2000 censuses,
- Total village population in 2000, and
- Prices in 1998 Mexican pesos for nixtamal (corn processed for tortilla dough), wheat flour, pasta, cookies, beans, eggs, sardines, sugar and oil.

In this stage of the analysis, the main objective is to estimate vector $\alpha$, which contains a coefficient for each variable in vector $K_i$ and a constant. Vector $\alpha$ is estimated using Ordinary Least Squares (OLS) described by equation (12):

$$\hat{\alpha}_{IV} = (\overline{K}'\overline{K})^{-1}\overline{K}'\bar{S} \tag{12}$$

Where $\bar{S}$, observed height, is a vector of $S_i$ to $S_n$, where *n* is the number of observations in the dataset. $\overline{K}$ is a *n* by *m* dimensional matrix, where each column is a vector $K_i$ and where *m* is the number of characteristics (the number of elements in vector $K_i$). Formally:

$$\bar{S} = \begin{bmatrix} S_1 \\ S_2 \\ \vdots \\ S_n \end{bmatrix}_{nX1} ; \overline{K} = \begin{bmatrix} K_{11} & \dots & K_{1m} \\ \vdots & \ddots & \vdots \\ K_{n1} & \dots & K_{nm} \end{bmatrix}_{nXm} \tag{13}$$

Vector $\hat{\alpha}_{IV}$ is used to estimate the instrumental variable with Equation (14):

$$\hat{S}_i = \hat{\alpha}_{IV}' K_i \tag{14}$$

The instrument for health is the estimation (by OLS) of height using the variables in vector $K_i$. This method allows for the correction of endogeneity between health and income, enabling us to establish a causal relationship in the desired direction (changes in income caused by improvements in health). The following assumptions need to be satisfied:

a) Our instrument must be correlated with health ($Corr\left(S_i, \hat{S}_i\right) \neq 0$)
b) Our instrument cannot be correlated with the error term, $\varepsilon_i$, of the explanatory equation for income ($Corr(S_i, \varepsilon_i | H_i, X_i, Z_i) = 0$).

Intuitively, the first condition states that we must select a suitable instrument for health; e.g. one that predicts health, and the second condition states that the instrument must not be correlated either with the dependent variable, health, nor with its underlying unobserved factors. In our context, both conditions imply that the only effect between the instrument and income must be thorough health; that is, once controlling for observable characteristics, the only association between income in 2017 and the instrument used is through the health variable.

Table D.1 shows output for the regression used to instrument height.

Table D.1 Regression to instrument height

| VARIABLES | Height |
|---|---|
| Gender | -9.504*** |
| | (0.196) |
| Migrant | -0.072 |
| | (0.196) |
| Youth's age | -0.225*** |
| | (0.013) |
| Weight | 0.549*** |
| | (0.040) |
| Weight$^2$ | -0.002*** |
| | (0.000) |
| *Marginalization* index 1995 | -1.202*** |
| | (0.345) |
| Village population in 2000 | -0.002*** |
| | (0.000) |
| *Marginalization* index 2000 | -0.757* |
| | (0.406) |
| Price of nixtamal | -0.030 |
| | (0.063) |
| Price of flour | -0.357 |
| | (0.221) |
| Price of pasta | 0.100 |
| | (0.108) |
| Price of cookies | -0.056 |
| | (0.036) |
| Price of beans | 0.065 |
| | (0.065) |
| Price of eggs | -0.002 |
| | (0.036) |
| Price of sardines | -0.015 |
| | (0.096) |
| Price of sugar | 0.247 |
| | (0.190) |
| Price of oil | -0.094 |
| | (0.096) |
| Constant | 144.903*** |
| | (1.538) |
| Observations | 4,740 |
| R-square | 0.588 |

Notes: Standard errors in parentheses. Level of significance *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

*Appendix E*

Table E.1 Contribution of PROSPERA to height and educational mobility, as well as to three other relevant variables, by time of exposure to the program

| | (1) | (2) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| VARIABLES | Height Mobility | Educational Mobility | BMI | Cognitive score | Memory score |
| Males | | | | | |
| Group 1 vs Group 0 | 2.404*** | 3.532*** | -6.411*** | 1.435*** | 0.896*** |
| | (0.587) | (0.311) | (0.712) | (0.251) | (0.172) |
| Observations | 435 | 561 | 550 | 542 | 562 |
| Group 2 vs Group 0 | 2.371*** | 2.648*** | -4.941*** | 0.984*** | 0.532*** |
| | (0.593) | (0.278) | (0.709) | (0.254) | (0.153) |
| Observations | 765 | 1,027 | 1,011 | 991 | 1,029 |
| Group 3 vs Group 0 | 1.380** | 2.345*** | -2.526*** | 0.498** | 0.532*** |
| | (0.562) | (0.309) | (0.485) | (0.222) | (0.140) |
| Observations | 467 | 619 | 609 | 596 | 620 |
| Group 1, 2 and 3 vs Group 0 | 3.309*** [a)] | 2.548*** | -4.628*** | 1.157*** | 0.683*** |
| | (0.686) | (0.228) | (0.748) | (0.288) | (0.161) |
| Observations | 1,329 | 1,756 | 1,729 | 1,696 | 1,758 |
| Females | | | | | |
| Group 1 vs Group 0 | 7.031*** | 3.715*** | -7.213*** | 1.664*** | 0.753*** |
| | (2.015) | (0.425) | (0.517) | (0.258) | (0.241) |
| Observations | 154 | 607 | 571 | 586 | 610 |
| Group 2 vs Group 0 | 4.049*** | 3.040*** | -5.826*** | 1.604*** | 0.704*** |
| | (0.628) | (0.390) | (0.624) | (0.226) | (0.218) |
| Observations | 349 | 1,351 | 1,283 | 1,301 | 1,353 |
| Group 3 vs Group 0 | 1.912** | 2.072*** | -2.643*** | 0.893*** | 0.552*** |
| | (0.887) | (0.408) | (0.457) | (0.179) | (0.203) |
| Observations | 206 | 809 | 773 | 777 | 811 |
| Group 1, 2 and 3 vs Group 0 | 4.093*** | 3.280*** | -5.064*** | 1.384*** | 0.829*** |
| | (0.620) | (0.427) | (0.652) | (0.193) | (0.216) |
| Observations | 553 | 2,243 | 2,121 | 2,170 | 2,246 |

Notes: [a)] The difference between the coefficient for the Group 1, 2 and 3 and the weighted average of the individual groups is due to the matching algorithm, which utilizes a different common support for the combined analysis than it utilizes for the individual analyses.
The estimates compare the difference between the matched indicator of the exposure group and that of the comparison group.
Variables used for matching: ln of the provider's height, eligibility score of PROSPERA in 1997 (linear and square), classification as poor household in 1997, youth's gender, provider's gender, provider's age (linear and square), provider's education, in 1997, two-months period when the transfers of PROSPERA were first received in the household of origin, number of persons in the household in 1997, and labor income of the household in 1997.
Standard errors in parentheses. Level of significance *** $p$<0.01, ** $p$<0.05, * $p$<0.1.
Source: |Estimations by propensity score matching based on data from the Evaluation of Rural Households Survey (ENCEL) 2017, complemented with data from the ENCEL panel 1997-2000.