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The effects of social pensions on nutrition-related health outcomes of the poor: Quasi-experimental evidence from Peru

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Abstract

This paper exploits the discontinuity around a welfare index of eligibility to assess the impact of Peru's social pension program *Pension 65* on nutrition-related health outcomes among elderly poor individuals. Overall, we find evidence of how a relatively inexpensive program can produce improvements in anemia and nutrition-related mortality risk markers. The effects appear to be driven by plausible underlying mechanisms, including via improved nutritional quality as well as greater food expenditures and healthcare utilization. These positive effects are only modestly countered by tentative signs of an increased obesity risk among women in the short term (<2 years), but not beyond this term. As the program evolves further, policymakers need to confront the challenge of continuing to ensure the health benefits in terms of reducing nutritional deficits while avoiding potential undesirable side effects in terms of over-nutrition in Peru. The findings may serve to highlight the wider benefits of similar pension policies for the poor also in other middle income countries, well beyond the immediate economic welfare effects that the policies have primarily been designed for.

KEYWORDS
aging, health, nutrition, poverty, social pensions

JEL CLASSIFICATION
H55, I12, I31

1 | INTRODUCTION

The significance of nutrition in older age is multifaceted, particularly in low- and middle-income countries (LMICs). As individuals age, their nutritional needs evolve (Tucker, 2010). Overall, energy needs tend to decline, as a result of declining activity levels. Yet, to avoid adverse health effects, they should not decline "too much" (as may occur in the context of poverty), since this would increase the risk of malnutrition among the elderly. On the other hand, in times of fast-paced socioeconomic development, there may equally be the risk of overall calorie intake - while being reduced in older age - remaining above the optimal level from a health perspective, thus increasing the odds of overweight and obesity, and its associated diseases. The sheer *quantity* of calorie intake is but one critical dimension of nutritional health in the elderly, with the *quality* of those calories, that is, their nutrient contents, representing the other - arguably even more concerning dimension. This is because while overall energy requirements tend to decline as we age, the requirement of nutrient quality does not decline in equal measure, but may even increase for some nutrients (Robinson, 2018). Taken together, the proper quantity and quality of nutrition can play a pivotal role in the overall health, cognitive function, and quality of life of the elderly, as it can mitigate the risks of chronic diseases, bolster the immune system, and enhance mental health (Bales et al., 2015). Given the fast aging population in many LMICs, particularly in Latin American countries, understanding the nutritional health of the elderly is important, as is the identification of policies that can help promote their dietary outcomes.

One of these policies, is the implementation of Non-Contributory Pension (NCP) programs in Latin American countries. These programs have been implemented with the primary objective of reducing poverty among the vulnerable, often uninsured elderly population. The schemes typically offer a regular transfer to elderly individuals who are not entitled to receive any other pension and live in poverty. While transfer generosity, coverage (targeted or universal) and access conditions vary in the region, the reforms do represent a step-change in the strategy to deal with social protection and poverty in old age, as reflected in the popularity and inherent long-term fiscal commitment of these programs.[1] Despite the promise raised by the new schemes, it is important to rigorously assess their impacts on different dimensions of the well-being of the recipients. The vast majority of the existing research has focused on assessing the impact of the programs on the economic welfare of the individuals and households (Lloyd-Sherlock & Agrawal, 2014), showing that many have achieved their stated objective of poverty reduction with remarkable success (Barrientos, 2012; Long & Pfau, 2009). The broader implications on the well-being of recipients, especially in areas like nutrition-related health, are equally crucial. Yet to date, there has been a noticeable gap in research focusing on other vital welfare outcomes, particularly nutrition.

The focus on economic outcomes might be legitimate under the assumption that old age income support would also “trickle down” to other aspects of well-being, including health and nutrition. While intuitive, this hypothesized link is by no means automatic and will depend on several factors. The relationship between pension income and health appears particularly nuanced (and may even be negative) in the context of nutritional health outcomes, since individuals make food choices based on preferences, and those preferences do not necessarily align with maximizing the nutritional quality of the food intake (Variyam, 2003). The capacity to convert pension income into better nutrition-related health depends not only on food intake but also on the availability of suitable health services, which is often very limited, particularly in rural and remote areas (WHO, 2008). The existing health systems in the region (and in low and middle-income countries more widely) were developed around a set of demographic and epidemiological conditions dominated by infectious diseases and malnutrition, which required reactive care to mostly acute conditions. Hence, the existing health systems tend to be less fitting to address the longer-term healthcare engagement needs and priorities of a fast-growing older population often affected by chronic conditions and functional limitations (Beard et al., 2012; Beran et al., 2019).[2]

In this paper, we assess the impact of *Pension 65*, an NCP program in Peru, on objective nutrition-related health outcomes. Our study stands out by examining a wide range of nutrition-related health outcomes and risk factors, filling a significant gap in the existing literature. We also estimate the heterogeneous effects of the program over time, and by gender. We identify the intention-to-treat (ITT) effects by means of a Regression Discontinuity Design (RDD) that exploits the discontinuity around the official eligibility welfare index of the program (the IFH index). We use the ESBAM survey (*Encuesta de Salud y Bienestar del Adulto Mayor*) that has been designed to facilitate the estimation of causal effects and that includes rich information on nutrition-related health variables, objectively measured, as well as some distinctive mechanisms, including nutrition quality. This survey also contains matched information on the administrative IFH index such that we obtain a very accurate measure of the assignment variable. That is, we observe the true distance of the individual's index to the eligibility threshold. Hence, individuals scoring just below the IFH cutoff of extreme poverty are eligible for the program, while individuals scoring just above the threshold are ineligible and act as the control group.

We focus on the nutrition-related health effects as our outcomes of primary interest, first, in light of the particular challenges in this domain, not solely in Peru but also in other Latin American and middle-income countries outside the region. Second, there is a dearth of evidence on the role that important social policies could play in mitigating the nutritional health problems of the elderly in LMICs. Peru faces a complex “double burden of malnutrition”, combining a considerable prevalence of overweight and obesity (and of associated chronic diseases) with a still notable prevalence of under-nutrition (Torres-Roman et al., 2017).[3] And although cardiovascular disease (CVD) risk factors are higher in urban and more affluent areas, there is recent evidence showing faster increases in body mass index and waist circumference in less urbanized regions (See Carrillo-Larco et al., 2016; Benziger et al., 2018; Carrillo-Larco et al., 2018). This suggests that the emerging transition from traditional to unhealthier diets in Peru could be reaching rural populations. It is therefore important to understand in how far large-scale public policies targeting (mostly) rural populations could impact (positively or negatively) on critical nutrition-related health outcomes in those groups.[4]

Other mechanisms we explore include health care utilization and proxies of sedentary or active lifestyles. The pension transfer might increase the use of medical services and treatments that could not be accessible without the program, thereby improving nutrition-related (but medical care amenable) health outcomes and risk factors. Similarly, substitution and income effects of the transfer may affect the intensity of physical activities (including working hours), which in turn might also impact on chronic disease risk factors and health outcomes.

Rare recent evidence on the impact of social pensions on domains outside economic welfare includes research on South Africa, documenting a positive effect of the social transfer on self-reported health of household members, improving the children's nutritional status and reducing the incidence of household members skipping meals due to lack of money (Case, 2004; Case & Menendez, 2007; Duflo, 2003). Using data on Russia, Jensen and Richter (2004) found that acute pension loss negatively impacted health and increased mortality. Cheng et al. (2018) find that China's New Rural Pension Scheme (NRPS) has improved objective measures of physical health, cognitive function, and psychological well-being of the rural elderly, as well as reducing mortality, yet modestly. Those outcomes appear to have been achieved via increased food consumption, better accessibility to health care, increased informal care and leisure activities, and a better self-perceived relative economic situation. Similarly, Huang and Zhang (2021) finds important effects of the NRPS program on reducing mortality. In Mexico, Salinas-Rodriguez et al. (2014) found the "70y *más*" social pension program led to an improvement in the amount and adequacy of protein and carbohydrate intake, with particularly beneficial effects among women, indigenous groups and poorer individuals. In addition, a study by Bando et al. (2020), also using ESBAM data, showed that *Pension 65* reduces labor supply, increases household consumption by 40%, and improves both mental health and subjective well-being.[5]

A small set of other papers has examined the impact of NCPs on food expenditures or food vulnerability of the elderly in Mexico (Aguila et al., 2017; Galiani et al., 2016; Juarez & Pfutze, 2020), Argentina (González-Rozada & Ruffo, 2016), Bolivia (Hernani-Limarino & Mena, 2016) and Chile (Miglino et al., 2023). With the exception of Hernani-Limarino and Mena (2016), who find insignificant effects, all of those studies demonstrate a positive contribution of NCPs on food expenditures, either for pensioners overall or for specific sub-groups, typically the more deprived and those living alone.

None of the above studies, however, has examined in depth the consequences of a major pension policy for the poor on a wide range of nutrition-related health outcomes and risk factors. In particular, the existing research does not appear to have been attentive to the possibility of adverse nutritional consequences that may at least be conceivable, in light of the above-mentioned double burden of malnutrition faced by several middle-income countries, including in Latin America. We also add to the existing literature an analysis of the potential underlying channels, by which the outcomes of interest may be affected, as well as an investigation of the heterogeneous effects (over time, and by gender) - both of which should aid our understanding of the policy impact, and in turn, better inform decisions about potential scale-up or modification.

We find that *Pension 65* reduces anemia and improve mortality risk markers (i.e., mid-upper arm circumference [MUAC]; calf circumference [CC]). We also investigate some mechanisms underlying the link between *Pension 65* and these nutrition-related health effects. In this regard, we find that the program improves nutrition quality (captured by the Mini Nutritional Assessment score and its single components), food expenditures, and health care utilization. Regarding the heterogeneous effects, we obtain that the reduction in the incidence of anemia is only significant for females but not for males, and the effect is significant for recipients receiving the transfer for less than 24 months (short run), but not for those receiving it for more than 24 months (longer run). The positive effects on MUAC hold in the short and longer term and for both genders, while the effects on CC also hold over either time span, but only for females. The health-improving effects we find are only modestly countered by some signs of an increased obesity risk among women (yet not for men).

The rest of the paper is organized as follows. Section 2 provides a overview of the *Pension 65* program. Section 3 describes the data and variables used. Section 4 presents our identification strategy to find the effects of the program in the RDD analysis. Section 5 presents our results, including an analysis of heterogeneous effects. Section 6 implements and discusses various robustness checks for the assumptions behind our design, and for our main findings. Lastly, Section 7 concludes.

2 | INSTITUTIONAL BACKGROUND

Peru introduced the non-contributory pension program *Pension 65* in October 2011. The program, administered by the Ministry of Development and Social Inclusion (MIDIS), provides a transfer of 250 Soles (about 33 USD per month) paid every other month. The transfer amount—that has not changed since its introduction in 2011—is equivalent (in monthly per capita basis) to 79.1% and 64.1% of the official poverty lines in rural and urban areas in 2019, respectively. In 2015, the year we use for our evaluation, the transfer represented 87.4% and 70.6% of the rural and urban extreme poverty lines. Although the transfer is relatively close to the extreme poverty line, note that the amount is 29% of the average per capita household income in the rural area and 12% in the urban area in 2015 (INEI, 2015). The program costs about 0.1% of GDP, making it one of the least expensive social pension programs in Latin America (see Figure A2). In 2019 there were 557,043 recipients, representing 20% of the population aged 65 and over.[6]

To be eligible to *Pension 65*, individuals must be at least 65 years old, not receiving pensions from any contributory pension system, and need to live in households officially classified as extreme poor. To verify whether a household is extremely poor, the program uses the official targeting system SISFOH (*Sistema de Focalización de Hogares*). This is a unified household registry that is maintained and used to compute targeting indicators for the social assistance policy in Peru. The registry draws on information about the socio-economic conditions of the households, that is collected by government officers. The largest roll-out of a census aimed to collect this data occurred in 2012, which is used to set up the sample framework of the survey we exploit in this study. The variables collected comprise: the access to basic infrastructure and its quality (water, electricity, sewage), fuel quality, material quality of the dwelling, home over-crowding, education attainment, home assets and health insurance access.

The information of the roll-out census is used to compute a weighted welfare index for the household, called IFH (*Indice de Focalización de Hogares*), which follows an official methodology involving distinctive region-specific weights for the variables, and regional cut-offs to establish poverty classification groups. Once the index is computed for each household, this is compared with regional specific thresholds in order to determinate whether the household is classified as (i) extreme poor, (ii) non-extreme poor, or (iii) non-poor. The classification is valid for a period of 3 years in urban areas and 4 years in rural areas. Importantly, the individuals do not know neither the algorithm to compute the index nor the score and eligibility thresholds; they only know their final poverty classification. Although the issue of manipulation of eligibility is an important challenge for social programs and the identification of causal impacts, we have not detected manipulation in the index around the eligibility threshold to the program (Section 6 deals with the analysis of possible manipulation).

People not surveyed in the roll-out censuses can apply to *Pension 65* at the municipality where they reside, and obtain an official poverty classification. The individual can be enrolled in the program as soon as the eligibility is confirmed, which takes around 25 days. Another way for enrollment is by means of information campaigns about the program that are jointly organized by local governments and officers from *Pension 65*. The program also searches for potential recipients who have not been yet classified in SISFOH or who have not received yet their official identity document (DNI), which is needed to assess the eligibility. These channels indicate that participation in the program is not fully assured because the individual is eligible, but requires an application to the program and validation of the extreme poverty condition.

3 | DATA

3.1 | The ESBAM survey

We use data from the *Encuesta de Salud y Bienestar del Adulto Mayor* (ESBAM), which was collected by the Peru's National Institute of Statistics (INEI) at the request of the Ministry of Economy in order to implement the impact evaluation of *Pension 65*. The baseline survey was carried out between October and December of 2012, while the follow-up survey was collected between July and September 2015. The survey was collected in 12 (out of 24) departments that had completed the roll-out of the SISFOH collection data, so that the sample framework design only considered these departments.[7] The sample framework was intentionally designed to implement an RDD utilizing the follow-up survey. This framework is composed of households where at least one member is aged between 65 and 80 and have a IFH index within 0.3 standard deviations above or below the threshold for extreme poverty. This design intends to obtain very similar households located in a small neighborhood around the eligibility threshold for *Pension 65*. Importantly, the ESBAM survey contains the official administrative IFH values for each household in our sample, which allows to work with a precise assignment variable and significantly attenuate the problem of measurement error (Davezies & Le Barbanchon, 2017; Pei & Shen, 2017).

The sampling procedure to select the households for ESBAM is probabilistic, independent in each department, and stratified by rural and urban areas. The primary sampling units (PSU) are defined as the census units in urban areas (blocks) and villages (*centro poblado*) in rural areas. In a first step, there is selection of PSU within each department and area according to a selection probability that is proportional to the total number of households. Then, in a second step there is a systematic random sampling of households.[8]

Figure 1 confirms that the ESBAM sample is indeed very local when we compare the IFH values of this sample with the national IFH distribution. Households located in the right side of the threshold are non-extreme poor (i.e., ineligible for the program) but are very close to qualify as extreme poor, and households located in the left side of the threshold are extreme poor and just eligible for *Pension 65*. The individuals of our sample are located around the eligibility threshold in a very narrow window, which can be seen in the gray area of (Figure 1).[9] That is, we are already using a very local design for our RDD approach. Our strategy basically compares the outcomes of those eligible individuals with that of those ineligibles. Any difference observed between these two groups could be attributed to the effect of *Pension 65* at the extreme poverty threshold, for the eligible group. Section 4 discusses with more detail the identification strategy.

3.2 | Sample selection

We use the ESBAM follow-up survey of 2015 to run our RDD. Our final sample is composed of 3351 individuals, of which 2190 are eligible and 1161 are ineligible. This means that the individuals from these groups have an IFH just above or below the extreme poverty threshold, respectively. To arrive at this number, we drop the following observations: 193 individuals that did not have IFH information, 105 who received the *Pension 65* transfer before the baseline survey, 82 with no information about receiving the *Pension 65* transfer, 57 classified as non-poor, 4 who were younger than 65 at the 2012 baseline survey, and 36 who are eligible and are receiving other pension benefits. This means that from an initial number of 3828 observations collected in 2015, we dropped a total of 477 observations. These selections are implemented in order to be able to use the IFH as the running variable in our RDD and to remove individuals who violate the sample framework (e.g., persons below age 65, being program recipients at baseline, receiving other pensions or being non-poor) and have key information for the RDD (e.g., being or not a recipient).[10]

3.3 | Variables

The ESBAM survey includes rich information about the living standards of the elderly, demographics, health, anthropometric measures, bio-markers, among others. The survey also includes household-level information such as consumption and income, and some demographic characteristics of other members. The information regarding the IFH score and whether and when the respondent received the transfer come from administrative registers.

3.3.1 | Nutrition-related health outcomes

ESBAM includes the measurement of the following objective health markers that have been collected by qualified personnel: arterial blood pressure, blood sampling to determine the presence of anemia, and anthropometric measures such as weight, waist circumference, mid-upper arm circumference (MUAC), calf circumference (CC), and arm-span. The anthropometric indicators are often included in geriatric health assessment, showing a strong predictive value for health status, mortality, nutritional status, and diseases. These measures may be more appropriate than the well-known Body Mass Index (BMI) to measure nutrition status and frailty among the elderly due to the changes in body composition during aging. For example, abdominal fat accumulation (which can contribute to disability and functional limitations) is better captured by increased waist circumference than by BMI (Seidell & Flegal, 1997; Seidell & Visscher, 2000). Waist circumference is also more closely associated with risks of

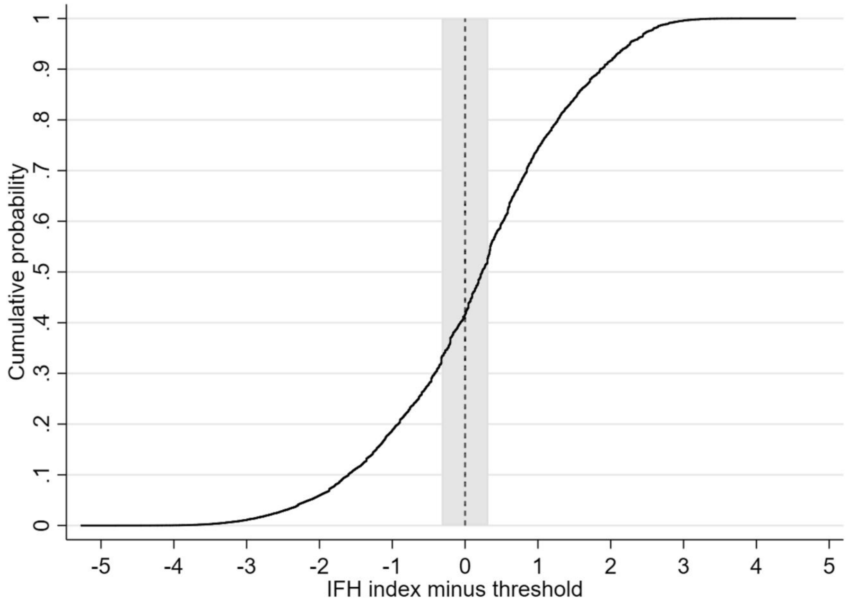

FIGURE 1 ESBAM sample observations within the IFH national distribution. The graph shows the cumulative distribution of the national standardized IFH among households (i.e., the IFH welfare index minus the extreme poverty thresholds). The data come from the 2012–2013 SISFOH census. The vertical dashed line is centered at zero and indicates eligibility (left) or ineligibility (right) to the program. The gray area around this line indicates the bandwidth where the individuals of our ESBAM sample are located (i.e., between −0.32 and 0.32).

cardiovascular disease and diabetes than BMI (Bjorntorn, 1997; Donahue et al., 1987; Rexrode et al., 1998). It is also difficult to obtain a correct measure of height among older adults due to shrinking and curvatures. We use the waist measure to assess abdominal obesity according to the cut-offs for waist recommended by the Latin American Diabetes Association (see ALAD, 2010; Pajuelo-Ramirez et al., 2019).

MUAC captures the nutritional status among older individuals. Due to its simplicity and the shrinking of old individuals, some studies have recommended their general use among the elderly individuals from developing countries instead of the BMI (James et al., 1994; Suraiya, 1999). Low muscle mass and/or low fat mass in older individuals (captured by low MUAC, an indication of thinness) contributes to the risk of mortality among older individuals (Schaap et al., 2018; Weng et al., 2018; Wijnhoven et al., 2010). Reductions in MUAC among people with an initial low MUAC are more strongly correlated with mortality than reductions in BMI (Schaap et al., 2018). There is some evidence suggesting that MUAC has a stronger association with mortality than alternative anthropometric measures (de Hollander et al., 2013).

CC also captures nutritional status. It has been found that low CC is more strongly associated with mortality than BMI (Wijnhoven et al., 2010; Weng et al., 2018) and other studies find a significant positive association between CC and the level of serum albumin, which is used to determine nutritional status. The subjects analyzed in Weng et al. (2018) who are in the highest tertile of MUAC (27.8 $\pm$ 2.2 cm) and CC (32.1 $\pm$ 2.6 cm) were shown to have a significantly lower mortality rate than the subjects in the lowest tertile.

Arm span can capture childhood development and nutritional status (Huang et al., 2013; Maurer, 2010). Moreover, it is considered a suitable surrogate for height, and one that is more reliable than alternative measures, due to the shrinking of the elderly individuals (Huang et al., 2013). For instance, de Lucia et al. (2002) used a proxy for BMI—based on arm span instead of height—to assess malnutrition, while Datta Banik (2011) found no statistically significant difference between height-based BMI and estimated arm span BMI.

3.3.2 | Mechanisms

The survey contains questions to compute the Mini-Nutritional Assessment (MNA). This indicator assesses the risks of under-nutrition and malnutrition of elderly individuals (Guigoz, 2006; Harris & Haboubi, 2005; Morley, 2011; Vellas et al., 1999). The questions are related to diet quality, mobility, disease history and anthropometric measures. The MNA has been used in the SABE survey (the Survey on Health and Well-being of Elders), a large-scale study carried out in the 2000s in seven capital cities of Latin America (Albala et al., 2005; Lera et al., 2016). For Peru, Leist et al. (2020) and Olivera and Tournier (2016) have used the MNA of ESBAM to study the relationship between nutritional status and cognitive functioning as well as multidimensional poverty. The MNA score ranges between 0 and 19 points according to 14 single items available in ESBAM, including six questions about diet quality. Besides exploiting the MNA score, we also include the analysis of these six single items, namely (i) Eating three or more meals per day; (ii) Eating dairy products at least once a day; (iii) Eating fruits and vegetables at least twice a day; (iv) Drinking less than three glasses of water per day; (v) Eating eggs, beans or legumes at least once a week; and (vi) Eating meat, fish or poultry at least three times a week.

Other variables capturing mechanisms for the transfer impacting on nutrition-related health outcomes are health care utilization, food expenditures and proxies for active and sedentary lifestyle. For a detailed list of all variable definitions and descriptive statistics, see Appendix B.

4 | IDENTIFICATION STRATEGY

According to the institutional setup, an individual is eligible to *Pension 65* if she is at least 65 years old, does not receive any pension, and lives in a household classified as extremely poor by the targeting system SISFOH (SISFOH, 2010). This means that the value of the welfare index (IFH) obtained by the household is below the cut-off separating between extreme poor and non-extreme poor. Variation of the index around the extreme poverty threshold provides a natural experiment that randomly assigns program eligibility. Thus, the control group are the individuals who are very close to the cut-off, but are narrowly ineligible. Following Bernal et al. (2017), we use a Sharp Discontinuous Regression Design (RDD) that includes the administrative IFH as a running variable.

Figure 2 plots the administrative IFH index centered at zero (i.e., the index minus its eligibility threshold), so that values of the *x*-axis lower than zero indicate extreme poverty, that is, eligibility to the program, which is why we expect a jump at zero. Our analysis is local in the sense that the individuals of the sample have a centered index very close to zero (it ranges between −0.32 and 0.32). This figure shows that being eligible by crossing the threshold significantly increases the probability to receive *Pension 65* (in 85.7% points), which strengthen the validity of our instrument.

The potential effect of *Pension 65* is identified by the difference between the average value of the outcome below the extreme poverty cut-off (eligible) and the average value of the outcome above the cut-off (not eligible). Formally, we use the following econometric specification to find the expected effects and assume linearity, so that we can estimate the expected effects of being eligible, that is, the intention-to-treat effects (ITT).

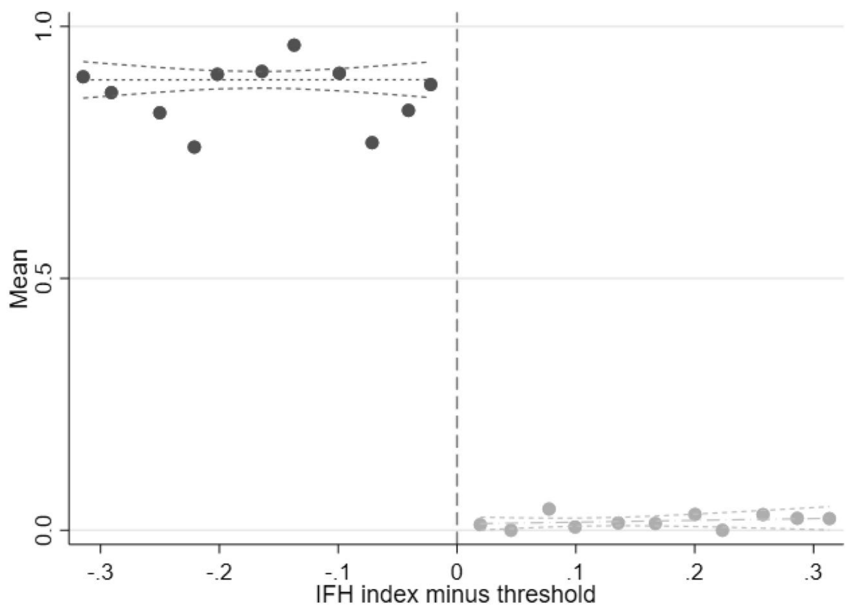

FIGURE 2 Probability of being recipient of *Pension* 65. The dots denote averages for equidistant cells of 0.03 points. Their size represents the number of observations. The regression lines and the 95% confidence intervals stem from separate linear regressions to the left and to the right of the threshold using the individual-level data.

$$y_i = \beta_0 + \beta_1 z_i + \beta_2 elig_i + \beta_3 z_i elig_i + X_i'\beta_4 + \varepsilon_i \quad (1)$$

where y_i indicates a health outcome variable in particular, z_i is the IFH index centered at its specific regional threshold, $elig_i$ is an indicator for the program eligibility, which takes a value of 1 when $z_i < 0$ (i.e., eligible) and takes value 0 otherwise, and X_i is a vector of controls. Our coefficient of interest is β_2, which we estimate with ordinary least squares (OLS). The regression controls are gender, age, years of education, head of household status, and married status. ε_i denotes the error term. Following the recommendations by Abadie et al. (2020) to deal with design uncertainty, we cluster the errors by Primary Sample Units (PSU) to adjust the standard errors of the estimates.[11]

We use the sharp type RDD design because we observe a high jump in the probability of receiving the transfer around the eligibility cut-off (see Figure 2). The main implication is that the expected effects (ITT) are mathematically similar to the Local Average Treatment Effect (LATE) estimator in a fuzzy design. The LATE effects in a Fuzzy RDD are the ITT effects deflated by the change in the probability of effectively receiving the treatment, which is obtained from the first stage. In addition, the interpretation of the ITT is more direct and does not only apply to people who effectively receive the treatment (i.e., the so-called compliers). We devote Section 6 to provide evidence about the assumptions of our identification strategy and robustness checks for our results.

For the estimation of heterogeneous effects, we propose the following equation:

$$y_i = \beta_0 + \beta_1 z_i + \beta_2 elig_i + \beta_3 z_i elig_i + \beta_4 G_i + \beta_5 z_i G_i + \beta_6 elig_i G_i + X_i'\beta + \nu_i \quad (2)$$

where G_i is a dummy variable revealing heterogeneity about two variables: (1) the duration of the treatment, that is, less than 24 months (short-term) or more than 24 months (long-term); and (2) gender. The ITT effect for those who were exposed to treatment for more than 24 months (i.e. $G_i = 1$) is captured by $\beta_2 + \beta_4 + \beta_6$; while β_2 identifies the effect for those who received the treatment for less time (i.e. $G_i = 0$). Recall that we measure the overall effect of program by comparing the control group individuals (who are just above the eligibility threshold) with the eligible individuals (who are just below the eligibility threshold). Thus, for the transfer duration analysis, we keep the same control group and compare them to two alternative treatment groups: (i) people who received the transfer for less than 24 months, and (ii) people who received the transfer for more than 24 months. This produces two effect estimates of the program on people with short or long exposure to the program. Therefore, we can interpret the results as what the effect of the program would be on those individuals who had a short (or long) exposure to the program relative to those who were not eligible. Equation (2) captures this logic.

The ITT effect for females (i.e. $G_i = 1$) is given by $\beta_2 + \beta_6$, while the coefficient β_2 gives the ITT effect for males (i.e. $G_i = 0$). The controls selected for the main estimates of the effect of program eligibility are the same as before.

It is worth mentioning that the access to the public health insurance SIS does not necessarily depend on being eligible for *Pension 65*. The eligibility for SIS is granted to individuals who live in households classified by SISFOH as poor, that is, being extreme poor or non-extreme poor. This implies that participation in *Pension 65* does not depend on SIS eligibility, nor does SIS eligibility depend on being enrolled into *Pension 65*. Rather, a recipient of pension 65 has the option to access to SIS services because she belongs to the eligible population. Note that this access would not generate bias in our estimates, since being eligible for the SIS is equally likely both for our control group (non-extreme poor) and for our treatment group (extreme poor).

5 | RESULTS

We analyze the effect of the program for six nutrition-related health outcomes that did not rely on self-reports, but were collected and measured by expert personnel during the interview: anemia based on the analysis of blood samples, weight, abdominal obesity, mid-upper arm circumference (MUAC), calf circumference (CC), and blood pressure. We also analyze some mechanisms that may have been driving the effect of the pension transfer on the above mentioned outcomes, which include nutrition quality, food expenditures, health care utilization, and physical activity. To illustrate how our identification strategy works, we show in Figure 3 discontinuities around the eligibility cut-off for one key outcome and one key mechanism. The plots show clear discontinuities indicating improvements in anemia and nutrition quality.

5.1 | Overall effects

As for the regression results, Table 1 reports the effects of *Pension 65* on the covered individuals. The table shows the overall potential effects and the respective baselines, which are OLS estimates of the mean outcomes conditional on the index being just above the threshold, so that individuals are just not eligible to the program. The estimates are very local, in the sense that we observe individuals with an administrative index that is within 0.3 standard deviations above or below the respective threshold for extreme poverty, which is a sufficient narrow bandwidth given by the ESBAM survey. We control for the value of the index separately to the left and to the right of the eligibility thresholds and we

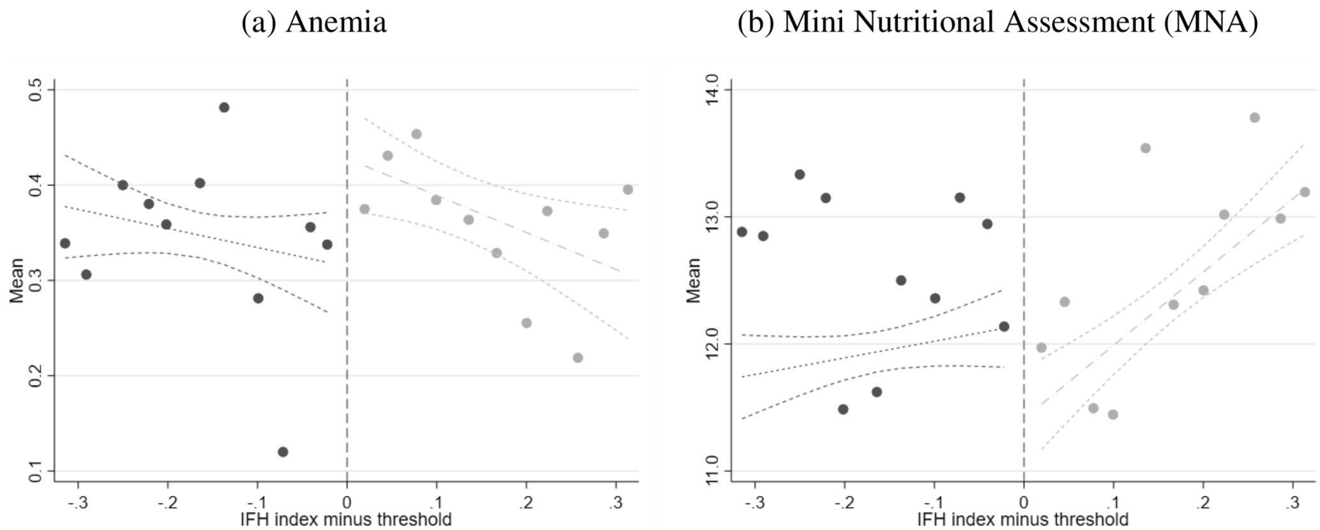

FIGURE 3 Selected effects of Pension 65. (a) Anemia. (b) Mini Nutritional Assessment (MNA). The dots denote averages for equidistant cells of 0.03 points. The regression lines and the 95% confidence intervals stem from separate linear regressions to the left and to the right of the threshold using the individual-level data.

TABLE 1 Effects of pension 65 on nutrition-related health outcomes.

Variables	Estimates	Baseline	Adj. *p*-value
Anemia (1/0)	−0.115***	0.377	0.009
	(0.04)		
Weight (kg.)	1.23	57.159	0.146
	(0.993)		
Abdominal obesity (1/0)	0.057	0.438	0.140
	(0.041)		
Mid-upper arm circumference (cm.)	0.927***	25.751	0.009
	(0.294)		
Calf circumference (cm.)	0.797***	31.932	0.009
	(0.265)		
High blood pressure (1/0)	0.052	0.431	0.146
	(0.046)		

Note: The column *Estimates* reports the estimated coefficient β_2 of Equation (1). The column *Baseline* reports the mean of the variable in the control group. All models control for age, gender, marital status, household head status, and years of education. Standard errors are clustered at the Primary Sample Unit (PSU) and are shown in parentheses. The adjusted *p*-values (or sharpened *q*-values) are corrected following the multiple hypotheses procedure of Anderson (2008).

*$p < 0.10$, **$p < 0.05$, and ***$p < 0.01$ indicate statistically significance levels according to clustered standard errors.

also add controls of age, gender, marital status, household head status, and years of education. The third column reports the adjusted p-values following the multiple hypotheses procedure of Anderson (2008).[12,13]

Our results indicate nutritional health benefits of NCP, specifically in terms of reducing under-nutrition proxies (e.g., lower incidence of anemia and improvements in the CC and MUAC measures). We find that the share of ineligible individuals with anemia is 38%, while for the eligible individuals, this is reduced by 12 p.p. This is at least qualitatively in line with findings from the quasi-experimental study by Aguila et al. (2015), who reported a lower incidence of low hemoglobin levels among the recipients of a regional social pension program in Yucatan, Mexico. In addition, the improvements in the MUAC and CC measures are also statistically significant: an additional 0.93 and 0.80 cm., respectively. This means that the program may have effects on delaying the loss of muscle mass and/or fat mass associated with aging, implying an expected reduction in mortality risk (de Hollander et al., 2013; Schaap et al., 2018; Wijnhoven et al., 2010).

As regards outcomes more reflective of chronic, non-communicable diseases (esp. overweight and obesity), we find no significant effects on weight and abdominal obesity. Moreover, high blood pressure saw no significant change.[14]

To shed more light on the link between *Pension 65* and the estimated health effects, we explore four potential transmission channels: nutrition quality, food expenditures, health care utilization, and activities as a proxy of sedentary or active lifestyle. The Table 2 reports the estimates of the effects of *Pension 65* on these mechanisms.

We observe important and statistically significant effects of the program on nutrition quality. While the average MNA score is 12.17 for the ineligible individuals, there is an overall increase of 0.79 for this score among the covered individuals, representing a 6.5% increase. As the MNA score is a screening tool capturing the risks of being malnourished, our findings suggest—taken together with the similar results on anemia reported in Table 1—that the program may be instrumental in addressing nutritional deficits.

The other indicators for nutrition quality in Table 2 are part of the single items used to compute the MNA score. In general, there are statistically significant, positive overall effects on eating dairy products, fruits and vegetables, and protein products (eggs, beans or legumes). There is also a reduction in the share of people drinking less than three glasses of water per day, which indicate an improvement in terms of hydration levels of the individuals. There are not statistical significant effects on the number of meals taken per day, or on eating meat, fish or poultry.

A second channel we explore is the income effect of the pension transfer on increasing food consumption. We capture this by assessing the effect of the transfer on household food expenditure per capita. Yet, this is an imperfect measure because we cannot identify the distribution of food among household members, we obtain that the program increases monthly food expenditures per capita by about 50 Soles, which implies an increase of 29% with respect to the food expenditure per capita of ineligible individuals. Even in a restricted sample of single households ($n = 527$) we obtain that program increases food expenditures of eligible individuals by 94 Soles, that is, 36% more than the food expenditures of ineligible individuals (unreported estimates).

A third analyzed channel is the utilization of health care services. Table 2 shows a statistically significant effect of the program on increasing the probability of being treated in a health center, up 18 p.p. (from 35.4% to 53.4%). It is important to bear in mind that eligible and ineligible individuals to the program receive SIS insurance and, therefore, they receive information about their illnesses, but only the extreme poor individuals (covered by *Pension 65*) receive some extra money that could be used to go to the facilities, get (new or update old) diagnosis and treat potential pre-existing conditions.

These results are consistent with the findings of Aguila and Casanova (2019), Cheng et al. (2018) and Lloyd-Sherlock and Agrawal (2014) who find greater access to medical care and greater visits to the doctor among the recipients of social pensions in Mexico, China and South Africa, respectively. Contrary to this, Bando et al. (2020) do not find a significant effect of *Pension 65* on the four outcomes they use to capture medical care utilisation.[15]

It is worth noting that our sample consists of an elderly population that will naturally require more medical care as they grow (even) older; so it is also natural to expect more consumption of medical care services. In our empirical strategy, we control for age, so the aging process is equally experienced by both eligible and ineligible individuals. Similarly, eligibility to SIS would not explain our results, since being eligible for the insurance is equally likely, both for our treatment group and for our control group (see Section 4). Thus, we attribute the effects on health care utilization to *Pension 65*.

The last analyzed channel that might help to explain our results is related to sedentary behavior and physical activity. A growing body of research has shown that sedentary behavior is associated with cardio-metabolic risk, sarcopenia (muscle loss that occurs with aging) and obesity (Chastin et al., 2012; Stamatakis et al., 2012). Existing evidence also suggests that physical activity is positively associated with health benefits and psychological well-being of the elderly (Wang et al., 2004), but no statistical significant effects of *Pension 65* on physical exercise were found. However, analyzing changes in working hours may be an indirect –albeit imperfect– way to capture changes in physical activity.

TABLE 2 Effects of pension 65 on nutrition quality and other mechanisms.

Variables	Estimates	Baseline	Adj. *p*-value
Nutrition quality			
Mini nutritional assessment (MNA) score (0–19)	0.785***	12.168	0.002
	(0.247)		
Eating three or more meals per day (1/0)	0.045	0.834	0.066
	(0.034)		
Eating dairy products at least once a day (1/0)	0.221***	0.291	0.001
	(0.05)		
Eating fruits and vegetables at least twice a day (1/0)	0.136**	0.503	0.008
	(0.054)		
Drinking less than three glasses of water per day (1/0)	−0.120**	0.443	0.008
	(0.047)		
Eating eggs, beans or legumes at least once a week (1/0)	0.119***	0.899	0.001
	(0.03)		
Eating meat, fish or poultry at least three times a week (1/0)	0.012	0.598	0.293
	(0.055)		
Other mechanisms			
Food expenditures (p.c. in Soles per month)	50.241***	174.60	0.001
	(14.003)		
Attended health center to treat illness (1/0)	0.180***	0.350	0.001
	(0.051)		
Working hours (hours a week)	−6.556***	19.26	0.002
	(2.016)		
Physical exercise (1–4 Likert scale)	0.077	1.330	0.128
	(0.087)		

Note: The column *Estimates* reports the estimated coefficient β_2 of Equation (1). The column *Baseline* reports the mean of the variable in the control group. MNA is a score for measuring the quality of diet and the risks of under-nutrition and malnutrition among old individuals, while the other reported variables are single items related to diet quality used in the computation of the MNA score. All models control for age, gender, marital status, household head status, and years of education. Standard errors are clustered at the Primary Sample Unit (PSU) and are shown in parentheses. The adjusted *p*-values (or sharpened *q*-values) are corrected following the multiple hypotheses procedure of Anderson (2008).

*$p < 0.10$, **$p < 0.05$, and ***$p < 0.01$ indicate statistically significance levels according to clustered standard errors.

For instance, a reduction in working hours may –ceteris paribus– be expected to entail a decline in overall physical activity, as the majority of our population of study works in agriculture and as street vendors (i.e., also involving manual labor). We find a reduction in working hours of about 6.6 h a week around the threshold among eligible individuals. Yet, these results should be taken with caution as we do not know with certainty how the individuals substituted their working hours. Although we do not find effects on physical exercise, other activities may have potentially increased but were not captured by the survey.

5.2 | Heterogeneous effects

Table 3 shows our estimates for the heterogeneous effects on nutrition-related health outcomes, both over the short versus longer term and by gender. The estimations of the effects by sub-groups reveal that the reduction in the incidence of anemia is statistically significant only for women (down by 18 p.p.) and in the short-term (less than 24 months). The

TABLE 3 Heterogeneous effects of pension 65 on nutrition-related health outcomes.

	Duration of the transfer		Gender	
Variables	**0–24 months**	**≥24 months**	**Male**	**Female**
Anemia (1/0)	−0.167***	−0.054	−0.066	−0.176***
	(0.043)	(0.057)	(0.055)	(0.053)
	[0.001]	[0.515]	[0.636]	[0.007]
Weight (kg.)	1.528	1.023	−0.194	2.739*
	(1.14)	(1.281)	(1.145)	(1.491)
	[0.119]	[0.515]	[0.873]	[0.047]
Abdominal obesity (1/0)	0.087*	0.026	−0.006	0.123**
	(0.048)	(0.052)	(0.053)	(0.056)
	[0.056]	[0.699]	[0.873]	[0.031]
Mid-upper arm circumference (cm.)	1.213***	0.624*	0.768**	1.069**
	(0.353)	(0.355)	(0.312)	(0.474)
	[0.002]	[0.247]	[0.093]	[0.031]
Calf circumference (cm.)	0.890***	0.722**	0.435	1.178***
	(0.307)	(0.337)	(0.294)	(0.398)
	[0.006]	[0.243]	[0.535]	[0.009]
High blood pressure (1/0)	0.047	0.056	0.053	0.049
	(0.05)	(0.058)	(0.061)	(0.062)
	[0.134]	[0.515]	[0.719]	[0.088]

Note: The columns 0–24months and *Male* report the estimated coefficient β_2 of Equation (2). The column ≥24months reports the estimated coefficient $\beta_2 + \beta_4 + \beta_6$ of Equation (2); and the column *Female* report the estimated coefficient $\beta_2 + \beta_6$ of Equation (2). The All models control for age, gender, marital status, household head status, and years of education. Standard errors are clustered at the Primary Sample Unit (PSU) and are shown in parentheses. The adjusted *p*-values (or sharpened *q*-values) are corrected following the multiple hypotheses procedure of Anderson (2008).

*$p < 0.10$, **$p < 0.05$, and ***$p < 0.01$ indicate statistically significance levels according to clustered standard errors.

significant increase on the MUAC is observed for both men and women, and in the short term. The positive effect on the CC is significant both in the short and long term, but this is significant only for women. The increase in abdominal obesity is significant only in the short term and for women, whereas the increase in weight seems to be concentrated only among women, although this result is only marginally significant.

Most of the positive effects appear to last only over the short term. The partial—and slightly worrying—flip side of the encouraging under-nutrition reducing effects is in the increase of abdominal obesity and weight of women. We detect that the incidence of abdominal obesity among women increases by 12 p.p., yet the increase is only weakly significant for individuals in the short term.[16]

Table 4 shows the heterogeneous effects of the program on mechanisms. The positive overall effect on MNA appears to be driven by the significant short run effect, which does not persist beyond 2 years. The effect holds for women and men, with women experiencing a larger impact (+0.95) than men (+0.64). While the effects on diet quality single items do not differ by gender, there are some differences across time. Eligible individuals are more likely to consume dairy and protein products and vegetables and fruits both in the short and long run, but the probability to eat three or more meals per day only increases in the long-run. There is a positive effect also on the probability of being able to drink more glasses of water per day, but only in the short-run.

Regarding food expenditures, the effects of the program are positive for both sexes, but they are concentrated in the short term. The effects on health care utilization is significant for both sexes and for individuals in the long term, perhaps reflecting repeated treatments and more diseases attended. Regarding the mechanism on activities, we observe significant effects only on working, but not on physical exercise. The estimates indicate a decline in working hours for

TABLE 4 Heterogeneous effects of pension 65 on nutrition quality and other mechanisms.

	Duration of the transfer		Gender	
Variables	**0–24 months**	**≥24 months**	**Male**	**Female**
Nutrition quality				
Mini nutritional assessment (MNA) score (0–19)	1.090***	0.439	0.635**	0.950***
	(0.294)	(0.297)	(0.317)	(0.318)
	[0.001]	[0.097]	[0.041]	[0.009]
Eating three or more meals per day (1/0)	0.009	0.089**	0.069	0.020
	(0.037)	(0.043)	(0.046)	(0.042)
	[0.211]	[0.051]	[0.078]	[0.221]
Eating dairy products at least once a day (1/0)	0.239***	0.205***	0.217***	0.223***
	(0.058)	(0.066)	(0.06)	(0.062)
	[0.001]	[0.006]	[0.002]	[0.004]
Eating fruits and vegetables at least twice a day (1/0)	0.140**	0.136**	0.132**	0.141**
	(0.06)	(0.067)	(0.065)	(0.063)
	[0.015]	[0.051]	[0.041]	[0.026]
Drinking less than three glasses of water per day (1/0)	−0.152***	−0.08	−0.100*	−0.144**
	(0.053)	(0.057)	(0.058)	(0.061)
	[0.006]	[0.100]	[0.069]	[0.022]
Eating eggs, beans or legumes at least once a week (1/0)	0.127***	0.111***	0.139***	0.096***
	(0.034)	(0.033)	(0.036)	(0.035)
	[0.001]	[0.005]	[0.002]	[0.014]
Eating meat, fish or poultry at least three times a week (1/0)	0.031	−0.004	−0.005	0.029
	(0.061)	(0.066)	(0.065)	(0.066)
	[0.211]	[0.250]	[0.207]	[0.221]
Other mechanisms				
Food expenditures (p.c. in Soles per month)	65.908***	30.947	44.113***	56.900***
	(15.701)	(18.791)	(16.034)	(16.652)
	[0.001]	[0.082]	[0.010]	[0.004]
Attended health center to treat illness (1/0)	0.095	0.279***	0.228***	0.125*
	(0.062)	(0.056)	(0.067)	(0.069)
	[0.068]	[0.001]	[0.003]	[0.041]
Working hours (hours a week)	−5.462***	−7.930***	−7.950***	−4.978**
	(2.039)	(2.924)	(2.809)	(2.096)
	[0.009]	[0.015]	[0.010]	[0.022]
Physical exercise (1–4 Likert scale)	0.146	−0.005	0.050	0.120
	(0.099)	(0.104)	(0.119)	(0.094)
	[0.068]	[0.250]	[0.201]	[0.100]

Note: The columns 0–24months and *Male* report the estimated coefficient β_2 of Equation (2). The column ≥24months reports the estimated coefficient $\beta_2 + \beta_4 + \beta_6$ of Equation (2); and the column *Female* report the estimated coefficient $\beta_2 + \beta_6$ of Equation (2). MNA is a score for measuring the quality of diet and the risks of under-nutrition and malnutrition among old individuals, while the other reported variables are single items related to diet quality used in the computation of the MNA score. All models control for age, gender, marital status, household head status, and years of education. Standard errors are clustered at the Primary Sample Unit (PSU) and are shown in parentheses. *$p < 0.10$, **$p < 0.05$, and ***$p < 0.01$ indicate statistically significance levels according to clustered standard errors. The adjusted p-values (or sharpened q-values) are corrected following the multiple hypotheses procedure of Anderson (2008).

both men and women (8 and 5 h), and a larger decline in the long run (7.9 h) than in the short run (5.5 h), which is in line with the aging and labor market retirement of the individuals.

The food expenditures represent 61% of total expenditures among the households of our sample, which is a high share but it is not unsurprizing given that our study population is composed of poor individuals. Therefore, it is expected that the pension transfer allocated to eligible individuals will have an important implication on the ability to buy food. Indeed, just one transfer from *Pension 65* is on average 28% of the household food expenditures among eligible individuals. Accounting for more than one transfer recipient within the household, this percentage could rise to 34%.

Overall, our analysis shows that individuals increase the consumption of food such as dairy products, fruits, vegetables, eggs, beans and legumes, which may have an overall positive impact on nutrition quality (i.e., a significant effect on MNA score) and, on the consumption of health care (nonfood consumption), which has indeed an effect on health outcomes. Nevertheless, it is worth noting that some of the effects fade over time and this could be because individuals in our sample are old poor people who have, very likely, experienced multiple deprivations over the life-course, and therefore they could already have a steep slope in their aging process. In this way, interventions such as *Pension 65* could boost health and well-being of the elderly poor in the short-term, but this cannot be sustained without other complementary policies.

6 | SENSITIVITY ANALYSIS

In this section, we explore the sensitivity of our results to the specification we choose and to the additional evidence we present to support our assumptions. First, we examine whether households might try to manipulate the IFH index to become eligible to *Pension 65*. Then, we assess whether eligible old-age individuals who have an index value just below the threshold are indeed similar to those ineligible who have a value just above it, so we test whether the expectation of some covariates are continuous functions of the index. Third, although the ESBAM sample is already very local, we conduct an even more local analysis by reducing the bandwidth sizes. Fourth, we analyze the sensitivity of our effect estimates to changing the thresholds. And finally, we assess whether the existence of other programs could challenge the validity of our results.

6.1 | Continuity of the running variable

An important robustness check in RD designs is to analyze the possibility that households can manipulate the running variable. In that case, the variation in treatment around the threshold would not be random anymore (Lee & Lemieux, 2010). This would occur if households had information on how the IFH and corresponding cut-offs are calculated, and, to the extent that they are interested in benefiting from *Pension 65*, they would accurately manipulate their answers in order to qualify for the program. While manipulation is always a risk, we believe it is unlikely in the case of our sample, due to both the eligibility methodology and the statistical tests for manipulation that we have employed. First, individuals are unlikely to know the precise algorithm behind the IFH computation. While the methodology is publicly accessible, it is complex to fully understand and replicate it. Second, the 15 different regional eligibility cut-offs (a mix of region, geographical area, and rural and urban areas) are unknown to the public, and therefore the individuals cannot be certain about the results of manipulating (if they do) their scores. Third, most of the variables used in the index construction are filled-in and verified by government officials and therefore difficult to manipulate. Therefore, manipulation in our case would be unlikely. We provide more details in the Appendix about the targeting system SISFOH and the construction of the IFH (see Section C of the Appendix).

Despite of this, we conduct two tests to evaluate whether the density of the score variable is continuous at the eligibility threshold. The IFH index is computed at the household level, so we conduct the analysis at the same level. The idea is that if there would be manipulation, then the IFH density will exhibit a discontinuity at the threshold. That means that many old-age households in our sample would be barely qualifying for Pension 65, that is, would have scores just to the left of the threshold. We analyze this by implementing the tests of Cattaneo et al. (2018) and Bugni and Canay (2021) on the whole ESBAM sample. In general, we do not find evidence for any significant discontinuity at the threshold. The p-values of the tests are 0.0959 and 0.606, respectively. Therefore, the null hypothesis of continuity is not rejected, and the manipulation problem described before is unlikely to occur.

6.2 | Expectation of covariates

In Section 4, one of our main assumptions is that, in absence of *Pension 65*, the outcome is a smooth function of the IFH. This means that eligible individuals who have an index value just below the threshold are similar to those ineligible individuals who have a value just above it. To test this, we explore whether the expectation of some covariates such as gender, age, years of education, marital status and being the head of the household are continuous functions of the index at the threshold. We use them as control variables in our main specification. Figure D1 and Table D1 in the Appendix summarize the results. We do not find evidence for any significant discontinuity.

Besides, we conduct separate analysis for the groups of people with short exposure (received the transfer for less than 24 months) and long exposure to the program (received the transfer for more than 24 months) and evaluate whether the expectation of covariates is also a smooth function of the index at the threshold value. Recall that in our main heterogeneous analysis, we keep the same control group and compare it to these two alternative treatment groups (see Table 3). Results are presented in Table D2 in the Appendix. In general, we observe no significant effects on covariates, with the exception of the variable of woman for the subsample with long exposure. What is picked up by this effect is that the fraction of women is lower in the subsample with long exposure compared to the control group and the difference is statistically significant at the threshold.[17] This could be explained by two reasons. First, the fraction of enrolled women at the beginning of the implementation of *Pension 65* was also lower (compared to that of men) and, therefore, we observe fewer women with long exposure to the program in 2015; and second, the linearity assumption may be too strong for this covariate in this subgroup. In any case, the effect on this subsample is not worrying because our main findings come from the people with short exposure to the program, so the main conclusions we have reached remain unchanged.

6.3 | More local analysis

It is standard practice to test whether the RDD results we presented so far are sensitive to different bandwidth sizes. Throughout the analysis, we have used the standard OLS estimator with a bandwidth size of 0.32 index points, which comprises the total observations of the ESBAM survey and it is already a very local bandwidth of the national IFH distribution (see Figure 1 and footnote 9 in Section 3.1). However, in this section we conduct an even more local analysis by reducing the bandwidth size to 0.25, 0.20 and 0.15 index points. In addition, we also conduct regressions using the non-parametric local-polynomial estimator (degree of 1 and the default optimal bandwidth selection) with robust confidence intervals following Calonico et al. (2014).

Table D3 in Appendix shows the results. In general, for the effects on health outcomes, nutrition quality and other mechanisms, the significance of the estimates prevails up to reducing the bandwidth size to 0.20 index points; thus the main conclusions we have drawn remain the same. The values of the estimates are larger, which is expected as we are conducting the analysis on a more local level. However, we do not get significant estimates for most of the variables when we reduce the bandwidth size to 0.15 index points for the OLS regressions or when we use the optimal bandwidth size for the non-parametric estimator. This is explained because we do not have enough power to detect significant effects as we have few observations for these more local regressions. The non-parametric estimator uses even smaller bandwidth size than the ones we show for the OLS case (between 0.06 and 0.08 index points) and therefore computes the estimates using very few observations (between 300 and 600 observations only).

6.4 | Changes in the thresholds

Here we analyze whether our main effects are sensitive to potential changes in the threshold. We compute the treatment effect derivatives (TED) suggested by Dong and Lewbel (2015). This analysis helps to approximate the impact on our estimated effects when there is a small discrete change in the threshold. The sign of the estimates would tell us whether the average effect of eligibility to *Pension 65* increases or decreases when the threshold is marginally changed. We implement this analysis by running OLS regressions using the specification in Equation (1), where β_3 captures the TED. The magnitude and significance indicate the stability of our results. A high TED estimate would indicate that slight changes in the running variable greatly affect the results. A positive (negative) and significant TED estimate would mean that the effects of being eligible to *Pension* 65 by just crossing the threshold will be higher (lower) compared to those shown in Table 1.

Table D4 in the Appendix shows the results. Focusing only on the main variables in which we already found significant effects, we observe that most of the TED estimates are not statistically significant, meaning that most of our results are stable when we change the threshold. More precisely, the effects on anemia and mortality risk markers (MUAC and CC) are stable. However, the TED estimates on the MNA score and the probability to drink less than three glasses of water are statistically different from zero, meaning that the effects on these variables are not very stable.

6.5 | Juntos program

Our identification strategy relies on assuming that jumps at the eligibility thresholds can be attributed to *Pension 65*. However, one can argue that the presence of other social programs could challenge this assumption.

One important program is *Juntos*, a conditional cash transfer program targeted to women that reaches rural areas. The program combines different eligibility criteria: the presence of mothers and children in the household, geographic targeting of the poorest districts and individual targeting based on the IFH index. So, it is unlikely that the effects we find in the paper on the elderly can be attributed to this program. Moreover, *Juntos*'s eligibility rule uses a poverty threshold, whereas we use a extreme poverty (lower) threshold in this paper; thus it is unlikely that the results we obtain could be affected by this program. There could be some cases however, in which there are households where an old adult lives with a young mother with children, but even in these cases both treated and control groups of elderly individuals would have the same probability to receive *Juntos*, hence there is no threat to our identification strategy.[18]

7 | CONCLUSIONS

By means of a regression discontinuity design around a welfare index of eligibility, we have assessed the impacts of *Pension 65*, a non-contributory pension program in Peru, on nutrition-related health indicators of poor elderly individuals. We have also explored the heterogeneity of the effects, in terms of gender and duration (short vs. long term effects).

Our results demonstrate that –overall– a relatively inexpensive social pension program may have important nutrition-related health effects on the elderly individuals living in extreme poverty. We found positive effects in terms of a reduction in the incidence of anemia and improvements in nutrition-related mortality risk markers. Underlying those effects appear to be improvements in nutritional quality, food consumption and utilization of medical care services. Moreover, the program tends to have more favorable effects on women than on men: the incidence of anemia among women is reduced, but not that of men.

Disaggregating the estimates, we obtain importance nuances in the effects, by gender and duration of exposure to the policy. For instance, the reduction in the incidence of anemia is only significant for females but not for males, and the effect is significant for recipients receiving the transfer for less than 24 months (short run), but not for those receiving it for more than 24 months (longer run). The positive effects on MUAC hold in the short and longer term and for both genders, while the effects on CC also hold over either time span, but only for females.

The health-improving effects we find are only modestly countered by some signs of an increased obesity risk among women (yet not for men). The latter results may tentatively signal a slightly augmented increased cardiovascular disease risk - a potential unintended side effect worth bearing in mind for policymakers. At the same time though, other chronic disease risk factors (e.g., blood pressure) showed no effect, underlining the more tentative nature of our conclusions about such unintended consequences.

As the program evolves further, and as Peru –and likely other Latin American and middle income countries– continue on their path of economic development and nutritional transition, policymakers may increasingly need to confront the challenge of continuing to ensure the health benefits in terms of reducing nutritional deficits while avoiding potential undesirable side effects in terms of over-nutrition.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they do not have conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] In Figure A1 of the Appendix we show the main features of NCP programs in Latin America as of 2018, that is, the annual cost and the coverage rate of the elderly population. We observe that Peru is one of the countries reporting one of the lowest costs (0.1% of GDP) and one of the lowest coverage rates of the population aged 60 and over (16%).

[2] While no single best strategy of improving the health of the elderly appears to be known yet, it is becoming increasingly clear that a broader public health approach (focused not only on economic outcomes) should be an integral part of an effective policy (PAHO, 2019; WHO, 2015).

[3] Although the majority of regions in Peru suffer from the double-burden of malnutrition (Chaparro & Estrada, 2012), the rates for under-nutrition, obesity and non-communicable diseases (NCDs) vary across regions (McCloskey et al., 2017; Miranda et al., 2011). For instance, the rate of stunting among children varies from 3% to 55% between regions (Martínez & Palma, 2014), and the prevalence of overweight and obesity varies from over 50% in coastal areas, including Lima, to between 40% and 50% in central and northern regions to below 30% in Huancavelica (Chaparro & Estrada, 2012).

[4] The co-existence of both "over" - and "under" - nutrition makes anticipating the impact of any income transfer on nutrition (and hence health) difficult. While there is abundant evidence of greater financial means helping individuals overcome situations of food and calorie scarcity, thereby mitigating problems of under-nutrition (Haddad et al., 2003), there is the risk of higher incomes contributing to excess calories or to the intake of more processed (and less nutritious, lower quality) foods and beverages (Popkin, 2009). This in turn may promote overweight and hypertension, as well as associated chronic diseases. In the specific Peruvian situation, it is important to understand, first, whether such compensating effects are happening, and if so, to whom they apply. This in turn would inform policymakers of potential unintended (health) consequences of NCP policies (and social protection policies in general). This may then help inform the design of complementary or alternative policies, addressing the complex health needs of an elderly population in demographic transition.

[5] Other studies using ESBAM data are Olivera and Tournier (2016) and Decancq et al. (2018). The former uses the baseline data of 2012 to assess the determinants of *successful aging* in combination with a multi-dimensional poverty counting approach; while the latter study uses a Dif-in-Dif design to study the normative properties of a multidimensional index of well-being.

[6] One year before the introduction of *Pension 65*, the government implemented a small scale pilot program of social pensions called *Bono Gratitud*, running from October 2010 to August 2011. The number of recipients reached 21,783 in August 2011 and were located in 14 departments: Amazonas, Ancash, Apurimac, Ayacucho, Cajamarca, Cusco, Huancavelica, Huanuco, Junin, La Libertad, Piura, Puno, Lima (metropolitan area), and Callao. While the eligibility conditions to access to this program were a minimum age of 75 and belonging to an extreme poor classified household, the transfer amount was 100 Soles. The roll-out of *Pension 65* started in October 2011 with the individuals living in the poorest districts located in six prioritized departments (Apurimac, Ayacucho, Huancavelica, Puno, Ica and Huanuco). Then, in May 2012 the affiliation was extended to include the 14 departments were the *Bono Gratitud* pilot program was in place.

[7] These departments are Amazonas, Ancash, Cajamarca, Cusco, Huanuco, Junin, La Libertad, Loreto, Pasco, Piura, Puno and Lima (provinces). Thus, our results do not necessarily apply to the whole population of poor elderly in Peru.

[8] For more methodological details consult MIDIS (2013).

[9] About 12.6% of households from the national IFH distribution are located within the IFH window considered for the sampling framework of ESBAM. Thus, the construction of the sample already considered a local framework.

[10] It is important to note that a similar sample selection procedure applied to the ESBAM baseline survey of 2012 reports a sample of 3828 individuals, meaning that there is information from both baseline and follow-up years for 3351 individuals, but not for 477 individuals

who are lost due to attrition. However, this will hardly bias our estimates as we detect that the relationship between attrition and eligibility is not significant (*p-value* = 0.56). For more details, check the report by MEF (2016) and Section 6.

[11] Note that this is an important difference with the study by Bando et al. (2020) who employ a variable called "conglomerate" to cluster the standard errors. These "conglomerates" are 15 geographic regions sharing the same administrative IFH cut-off used to determinate poverty. Thus, these areas have not relation with the sampling framework, and therefore using them to cluster errors does not reduce design uncertainty. In addition, these areas can group very dissimilar localities with quite some distant among themselves, and hence it is not completely correct to use "conglomerates" as a sort of variable to control for regional fixed effects. Another difference with the mentioned study is that we do not use "conglomerate" fixed effects, while they do. The reason is that the running variable z_i has already been centered at the "conglomerate" cut-offs.

[12] This procedure uses the free step-down re-sampling method to control the family-wise error rate, that is, the probability of rejecting at least one true null hypothesis in the group of hypotheses under test.

[13] We also conduct a more local analysis and non-parametric regressions following Calonico et al. (2014) (see Section 6.3). Our main effects remain.

[14] The ESBAM survey does not allow us to compute BMI because it only measures weight, but not height.

[15] Only one of these outcomes could be similar to ours (attended health center to treat illness in the last month). Moreover, recall that study also uses ESBAM data but there are some methodological differences with respect to ours.

[16] When we use waist circumference instead of the dummy variable for abdominal obesity, we note that women experience a statistically significant increase of 3.5 cm. Following the review by Verweij et al. (2013)—and while acknowledging the mixed evidence base on the subject—the magnitude of the estimated increase may be interpreted to be at the lower end of the spectrum of clinically relevant effects. Since other chronic disease risk factors (blood pressure in our study) did not see a significant change, these findings might raise some modest concerns about potential adverse side effects of the program, at least in terms of women's cardiovascular risk.

[17] The participation of women in the control group, short and long exposure groups are 48.6%, 45.4% and 42.2%, respectively.

[18] A condition to receive *Juntos* is living in a household classified as poor, which includes extreme poor and non-extreme poor households. Recall that all members of our sample, eligible and ineligible, belong to these groups.

[19] The specific regulations about the creation of the SISFOH and the standardized form named "Ficha Socioeconomica Unica" (FSU) are included in the ministry decrees 399-2004-PCM and 400-2004-PCM.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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