

Effects of the Continuous Benefit Programme on the nutritional status and food security of older persons in Brazil

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Received: 17/11/2022
Accepted: 22/03/2023

Abstract

Addressing the needs of older persons poses public-policy challenges. The obstacles that the poorest older persons face in securing their livelihoods, compounded by physiological and metabolic changes and the presence of chronic diseases, make them more vulnerable. This study evaluates the impact of the Continuous Benefit Programme (BPC) on the nutritional status and food security levels of older persons in Brazil, using a fuzzy regression discontinuity design with microdata drawn from the 2017–2018 Consumer Expenditure Survey (POF). On average, participation in the programme is found to increase the probability that an older person will be food-secure, and to reduce his/her chances of suffering mild food insecurity. Although the objective of the programme is to reduce poverty, these findings can support the formulation of public policies that promote the quality of life of older persons, by acting on purchasing power, health and nutrition.

Keywords

Ageing persons, health, social welfare, nutrition, nutrition programmes, food security, programme evaluation, Brazil

JEL classification

H43, I38, C31

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I. Introduction

Food insecurity and its most serious manifestation —hunger and the various forms of malnutrition— are on the rise in Latin America and the Caribbean and are impeding progress towards the Sustainable Development Goals (SDGs). The persistent effects of the coronavirus disease (COVID-19) pandemic, compounded by climate crises and the conflict in Ukraine are identified as the main phenomena hindering this progress (FAO and others, 2022). This is particularly the case with respect to Goal 2, which overlaps with the other goals of the 2030 Agenda for Sustainable Development (Pérez-Escamilla, 2017).¹

In this context, the problems of food insecurity and malnutrition (including both obesity and undernutrition) and have regained importance on the public policy agenda, since they affect millions of people worldwide. According to the World Health Organization (WHO, 2021), the global prevalence of obesity increased from 8.7% of the population in 2000 to 13.1% in 2016. The phenomenon of increasing obesity is not exclusive to high-income countries (Cawley, 2010). According to WHO (2021), middle-income countries also display high rates of obesity, including Mexico (28.9%), Argentina (28.3%) and Chile (28%). In Brazil, where the same global trend is observed, the percentage of people who are obese increased from 14.5% in 2000 to 22.1% in 2016 —the latter being above the world average of 13.1% in that year.

According to the Brazilian Institute of Geography and Statistics (IBGE, 2010), the obesity rate was 17.9% among 65–74 year-olds in 2008–2009 and slightly lower among those aged 75 years and older (15.8%). In 2018, the obesity rate among persons over 65 years of age reached 20.3%, being higher among women (23.4%) than among men (15.3%) (Ministry of Health, 2018).

In the case of undernutrition, WHO (2021) reports a drop in prevalence from 11.3% of the world's population in 2000 to 9% in 2016. While the rise in obesity rates is the most alarming nutritional problem, undernutrition remains a serious issue. In Brazil, undernutrition decreased from 4.4% in 2000 to 2.7% in 2016. In the same period, the undernutrition rate among 65–74 year-olds group was 3.2%, while among persons aged 75 years and older it stood at 4.4%. These values are above the average rate of undernutrition in the Brazilian population at large (2.7%) (IBGE, 2010).

The spread of obesity is worrying because of its potential to foster chronic noncommunicable diseases and, consequently, loss of quality of life, risk of premature death and increased health costs, among other problems (WHO, 2015; Carvalho and others, 2021; Chooi, Ding and Magkos, 2019). In contrast, undernutrition is of concern because of its relationship with infectious diseases that interfere with nutrient absorption (Keusch, 2003). The metabolic and physiological changes inherent to the ageing process diminish the functionality of the human body; and, in addition, they increase the vulnerability of older persons, owing to the existence of clinical conditions with diseases that can cause changes in eating behaviours (Ipuchima and Costa, 2021).

Nutritional status is defined as the result of the balance between the body's nutrient intake and its energy expenditure. Nutritional disorder is one of its organic manifestations, including both obesity caused by an excess of nutrients and undernutrition caused by their scarcity (Ministry of Health, 2011). Malnutrition problems are persistent in the population, especially among the socioeconomically vulnerable, such as older persons, who are more at risk. In the case of Brazil, Travassos (2018) notes that older persons are vulnerable to income shocks, owing both to low productivity and conditions for remaining in the labour market. This situation increases the chance of suffering from a nutritional disorder (such as obesity or undernutrition) and accentuates poverty and food insecurity.

Huenchuan (2018) argues that socioeconomic inequality is very closely related to higher rates of hunger, obesity and undernutrition among the most vulnerable population groups. The reason is that the high costs of nutritious foods and the budgetary constraints faced by older persons lead them to choose

¹ The 2030 Agenda for Sustainable Development contains 17 goals and establishes a transformative vision towards the economic, social and environmental sustainability of the countries that adopted it in 2015 (ECLAC, 2023).

cheap foods and diets that are hypercaloric, lacking in variety and nutrient-poor (FAO/IFAD/WFP, 2015). In Brazil, several studies have noted the influence of socioeconomic factors on obesity, particularly income and education (Silva and others, 2015). Triaca, dos Santos and Tejada (2020) found that income is the factor that contributes most to the spread of obesity in the country. However, while a larger income might enable access to more nutritious food, there is no certainty about the allocation of household resources in terms of the quantity and quality of food, because other factors such as price, preferences and socioeconomic levels influence this decision (Simões and others, 2018). Obesity continues to spread in Brazil; and income is a decisive risk factor for this disease, along with dietary diversity, education, occupation and organic factors, among others. Lima and others (2015) and Malta and others (2019) also analysed the problem of obesity in Brazil; but there are few analyses of the prevalence of obesity and undernutrition and their relationship with income among older persons in the country.

According to the Food and Agriculture Organization of the United Nations (FAO and others, 2018), 821 million people suffered from hunger in 2017, while the prevalence of food insecurity increased from 7.6% in 2016 to 9.8% a year later. Food and nutrition security is defined as when all people, at all times, have physical and economic access to food, in sufficient quantity and quality to meet their nutrient needs (FAO and others, 2018). The status of food and nutritional security can be determined using the Brazilian Food Insecurity Scale (EBIA), which distinguishes four levels: (i) food security, when access to both household and individual food is regular, permanent, of quality, sufficient and does not compromise the attainment of other essential needs; (ii) mild food insecurity, which defines a situation of uncertainty about food in the future; (iii) moderate food insecurity, which occurs when there is a quantitative reduction of food among adults; and (iv) severe food insecurity, when the reduction of food in the household also affects children (IBGE, 2020a).

In Brazil, data from the latest (2017–2018) Consumer Expenditure Survey (*Pesquisa de Orçamentos Familiares – POF*) show that the prevalence of food insecurity increased to 36.1% from 22.9% in 2013 (IBGE, 2020a). Drawing on EBIA, Silva and Bento (2019) noted that the food security of an older population group was 8%, while the prevalence rates of mild, moderate and severe food insecurity were 24%, 40% and 28%, respectively.

Older persons are projected to represent 25.5% of the Brazilian population in 2060 (IBGE, 2020a), which poses major budgetary challenges for health care in this age group. In this context, social protection and, in particular, non-contributory pensions are being used increasingly to reduce the vulnerability of older persons to income shocks (Brugh and others, 2018).

One such initiative implemented in Brazil is the Continuous Benefit Programme (*Benefício de Prestação Continuada – BPC*), which aims to reduce poverty among older adults and persons with physical disabilities. The programme involves the transfer of one current minimum wage per month, as a social right guaranteed by the Federal Constitution of 1988 and regulated by the Organic Act on Social Assistance, No. 8742, of 1993 (Denes, Komatsu and Menezes-Filho, 2018). Persons aged 65 years or older with a per capita family income of no more than one-quarter of the current minimum wage are eligible to receive the benefit. According to the Economic Commission for Latin America and the Caribbean (ECLAC, 2019), when the programme was created in 1996, it only served 41,992 older persons and had a budget of R\$ 24 million, which represented 0.02% of gross domestic product (GDP). In 2018, the programme served approximately 2 million older persons, with a budget of R\$ 23 billion equivalent to 0.77% of GDP.

Social pensions have proven effective at enhancing food and nutrition security, since income transfers influence allocation of household resources (Brugh and others, 2018), with significant effects on the dimensions of food security (Bottan, Hoffmann, and Vera-Cossio, 2021; Bhalla and others, 2018; Tiwari and others, 2016).

In Brazil, it has been found that BPC increased food consumption and health expenditures (Ferrario, 2013; Oliveira, Kassouf and Aquino, 2017). According to Tapajós and Quiroga (2010), 51% of the older persons receiving BPC were food-insecure. Similarly, a study by the Ministry of Social Development

and Fight against Hunger (2010) found that 61% of BPC beneficiary families were food-insecure. It should be noted that the studies in question do not assess the impact of the BPC programme on food and nutritional security. While the first study was of municipal scope (it was conducted in 543 Brazilian municipalities), the second drew on BPC administrative records for all beneficiaries (both older persons and persons with disabilities). Accordingly, there is a lack of studies on BPC relating to older persons specifically, both throughout national territory and in terms of evaluating the impact on the different levels of food and nutritional security. The present research uses EBIA to determine the impact of BPC on food security and on mild, moderate and severe food insecurity.

In this context, it is recognized that there may be errors in public policy actions, especially in addressing the prevalence of obesity and undernutrition and the persistence of food insecurity among older persons. These errors should be rectified to enhance the efficiency of the programme in reducing poverty and its cross-cutting axes, such as those analysed in this research.

This study investigates the impact of the BPC programme on changes in nutritional status and food security levels among older persons, using the fuzzy regression discontinuity design method to evaluate the effects of BPC on the aforementioned outcome variables. The research aims to enhance understanding of the nutritional status and food security levels of Brazil's older persons. The results provide evidence to enrich the debate and improve public policy action to achieve the programme's explicit objective of reducing poverty. By using the 2017–2018 POF for impact evaluation estimations, the research covers older persons nationwide. The 2017–2018 edition of the POF presents EBIA data for the first time, which contains records of food security and mild, moderate, and severe food insecurity. This helps to reinforce the originality of the research and to analyse how BPC affects these outcome variables among older persons.

The article is divided into six sections, including this introduction. While section II describes the characteristics of BPC, section III presents the fuzzy regression discontinuity design as an empirical strategy for the estimations. Section IV describes the variables and data source, and section V presents the research findings. Lastly, the section VI draws conclusions.

II. Characteristics of the Continuous Benefit Programme (BPC)

According to Dodlova, Giolbas and Lay (2018) and Cecchini, Villatoro and Mancero (2021), social assistance mainly comprises two types of programme: conditional cash transfers and social pensions or unconditional cash transfers. The main objective of these programmes is to reduce poverty among the target population. Conditional cash transfers provide cash grants along with services such as education and health to children and adolescents. The beneficiaries are required to comply with certain rules or types of behaviour (conditionalities) to be able to participate and remain in the programme. In contrast, social pensions are cash transfers to older persons and persons with disabilities. Apart from fulfilling the eligibility criteria, there are no other conditions for receiving the benefit. Nonetheless, remaining in the programme will depend on the criteria chosen in each context. As social assistance programmes, they do not depend on a person's current or previous participation in the formal labour market; and their importance for social policy depends on the coverage of the target population, the share of GDP and welfare effects (Dodlova, Giolbas and Lay, 2018; Cecchini, Villatoro and Mancero, 2021).

The Continuous Benefit Programme forms part of a social pension and is a right provided for in the Federal Constitution of 1988. It was regulated by the Organic Act on Social Assistance, No. 8742, of 1993 and pays an amount equivalent to one minimum monthly wage to persons with disabilities and older persons who demonstrate that they lack the means to support themselves (Brazil, 1993).

The benefit is granted to older persons following the verification of eligibility criteria, such as age and per capita family income. Recently, Act No. 14.176 of 2021 amended the per capita family income criterion for accessing the benefit, by stipulating additional parameters characterizing a situation of social vulnerability, such as health expenses (Brazil, 2021).

To give an idea of the size of BPC, figure 1 shows how the number of older person beneficiaries has grown since the programme's inception in 1996. In that year, when the benefit was first implemented, it covered 41,992 older persons, representing 12.13% of total programme beneficiaries. In 2003, following the change in the age eligibility criterion to 65 years, the programme benefited 664,875 older persons. As of 2005, more than 1 million older persons were receiving BPC and, as of 2017, the number surpassed 2 million. There was also a significant increase in 2021, owing to measures adopted to address the COVID-19 pandemic. The new strategies implemented by the Government in relation to BPC, to help combat the pandemic and prevent poverty among older persons, include the following three: the diversity of care channels already promoted earlier by the National Social Security Institute (INSS); the advance payment of BPC for the same amount as Emergency Assistance (*Auxílio Emergencial*) to older persons who were waiting for their INSS application to be processed; and temporary suspension of the deadlines for enrolment in the Single Register (*Cadastro Único*) (Ministry of Citizenship, 2021).

Figure 1
Brazil: older person beneficiaries of the Continuous Benefit Programme and growth rate of the older adult population, 1996–2021
(Percentages of total beneficiaries and of the older adult population)



Source: Prepared by the authors, on the basis of Ministry of Social Development and Hunger Alleviation, Economic Commission for Latin America and the Caribbean (ECLAC), Non-contributory Social Protection Programmes Database in Latin America and the Caribbean [online] <https://dds.cepal.org/bpsnc/home>; Brazilian Institute of Geography and Statistics (IBGE), *Pesquisa de orçamentos familiares 2017–2018: análise da segurança alimentar no Brasil*, Rio de Janeiro, 2020.

A key factor in the expansion of the programme's coverage during the period under review have been the successive changes made to the age-based eligibility criteria. When the programme was created, the minimum age for receiving the benefit was 70 years. In 1998, this was lowered to 67 years, by Act No. 9720 of 1998 (Brazil, 1998); and in 2003 it was reduced to 65, under Act No. 10741 of 2003 (the Older Person's Charter) (Brazil, 2003). The minimum 65 year-old threshold for applying for the benefit still remains in force, pursuant to Act No. 13982 of 2020 (Brazil, 2020).

Another key feature of BPC coverage is the ageing process itself among Brazil's older population, as a result of increased life expectancy (currently 77 years) and improved health conditions (IBGE, 2022a). According to IBGE estimations (2020a), the older population (aged 65 and over) has been growing by more than 3.0% per year since 2002 and expanded by 3.8% in 2021. The 2010 census revealed that the total number of older persons in Brazil was 19.6 million, representing approximately 10.2% of the national population (Silva, 2010; IBGE, 2022b). In the next 40 years the older population is set to increase by 3.2% per year, to reach 64 million persons and 29.7% of the total population in 2050 (IBGE, 2022b). The increasing share of older persons in Brazil's total population is explained by a declining fertility rate, which has modified the demographic profile since 1960 and is changing the population growth rate and age structure. In other words, the number of children and adolescents is not keeping pace with the adult and older person population (Simões, 2016).

III. Fuzzy regression discontinuity design

When evaluating a public policy, various methods can be used to judge whether the policy affects the beneficiaries as intended (Khandker, Koolwal and Samad, 2010). Angrist and Pischke (2009) argue that the causal relationship of interest will determine the impact of a policy on a given characteristic (such as poverty or nutritional status, among others); and it will make it possible to predict what would happen if the underlying conditions were changed. In a randomized experiment, the treatment and control groups may consist of very similar units, so a simple difference in means would be sufficient to compare the two groups (Gertler and others, 2016).

There is no evidence that participation in the BPC programme is randomly assigned. All persons aged 65 or older whose per capita family income is no more than one quarter of the current minimum wage are eligible to apply for the benefit. In this situation, measuring the effect of the programme by the difference in means across the entire population would make no sense; and it would produce biased estimates, owing to the non-random nature of assignment to the programme and the fact that older persons would self-select for participation. Accordingly, the effect of BPC must be estimated for those in the treatment group. However, older persons exposed to the treatment cannot be observed at two points in time, so there is no comparison group to represent those that did not receive BPC.

To overcome these problems, this research adopts the regression discontinuity design, in which participation in a treatment is determined by a threshold c , related to a continuous forcing variable, X_i . In this case, the forcing variable is the age of the older person, which determines eligibility for the programme. Specifically, the fuzzy regression discontinuity design case is used to estimate the average local effect of exposure, since in the fuzzy design the probability of participation in the treatment does not necessarily jump from 0 to 1 at the cut-off point c , defined as 65 years of age, because there are other observable and unobservable variables that determine this probability. This is true in the case of BPC, where receipt of the benefit does not depend on age alone, but also on per capita income and other factors, both observable and unobservable. The latter ignorance of the possibilities of the BPC, the work done by municipalities to identify candidates, and the motivation to participate (Oliveira, Kassouf and Aquino, 2017). Thus, being older than the threshold age c increases the probability of receiving treatment if candidates are also motivated to participate in the programme, for example. The assumptions for identifying the local average treatment effect (LATE) in the fuzzy design fulfil the regression discontinuity design's own assumptions (local continuity and ignorance) and those of the instrumental variable estimator: monotonicity, independence, and exclusion restriction (Menezes, 2012).

Given these specifications, LATE can be estimated directly in the fuzzy regression discontinuity design using a regression model that combines the regressions on both sides of point c , as represented by equation (1). Since the treatment condition is only partially determined by the eligibility rule, it is

first necessary to estimate how the probability of participating in the treatment is related to the forcing variable, using two-stage least squares (2SLS). According to Menezes (2012), Lee and Lemieux (2010) and Fonseca (2017), the first stage of the estimation is represented by equation (2), which, in this case, relates the age of the older person and the treatment effect, as presented below:

$$y_i = \alpha_l + \tau * T_i + \beta_l * (X_i - c) + (\beta_r - \beta_l) * T_i * \varphi * (X_i - c) + \sum_{j=1}^J \tau_j * W_{ij} + \varepsilon_i \quad (1)$$

if $c - h < X_i \leq c + h$

$$T_i = \gamma_l + \theta * D_i + \delta_l * (X_i - c) + \pi * D_i * (X_i - c) + e_i \quad (2)$$

if $c - h < X_i \leq c + h$

where,

$$D_i = \begin{cases} 1 & \text{if } X_i \geq 65 \\ 0 & \text{if } X_i < 65 \end{cases} \quad (3)$$

In equation (1), T_i is the treatment condition for those who actually receive BPC; $\tau = \alpha_r - \alpha_l$ is the local average treatment effect, represented by the difference between the intercepts of the linear functions on either side of the threshold, c ; $\varphi = \beta_r - \beta_l$ is the parameter of the difference between the gradients of the regression lines, where β_l is the gradient of the line on the left side of the cut-off point, c ; β_r is the gradient of the straight line on the right side of c . X_i is the treatment assignment variable, in this case the age of the older person; W_{ij} is the sum of the covariates represented by the characteristics of older persons, households, location and regions.

Equation (2) relates the probability of receiving the treatment with X_i . In this case, T_i is the treatment condition, which takes the value 1 for those who receive BPC and 0 for those who do not; D indicates whether X_i exceeds the value c ; D is a dummy variable equal to 1 if X_i is older than 65 years and 0 otherwise, as specified in equation (3). $\theta = \gamma_r - \gamma_l$ is the difference between the intercepts of the linear functions on either side of the threshold c ; $\pi = \delta_r - \delta_l$ is the parameter of the difference in the gradients of the regression lines; δ_l is the gradient of the straight line on the left side of c , and δ_r is the gradient of the straight line on the right side of c .

In determining the local average treatment effect for older persons whose participation status changed at age 65, LATE compares only older persons within the bandwidth (h) around the threshold. However, if the units studied are very different from the other units in the population of interest, the LATE found using the fuzzy regression discontinuity method should not be extrapolated to the rest of the population, as indicated by Menezes (2012).

IV. Description of variables and data source

This study uses microdata sourced from the 2017–2018 Consumer Expenditure Survey (POF), which compiles socioeconomic data on individuals and households drawn from a sample of the Brazilian population. The sample consists of older persons aged 65 years or more living in households in which the BPC cash transfer forms part of the family income. The control group consists of older persons who are below the cut-off point, c ; in other words those who are not eligible for the programme because they are under 65 years of age.

To measure nutritional status, the body mass index (BMI) is calculated as weight divided by height squared (kg/m^2) using the anthropometric indicators of weight and height available in the 2017–2018 POF. In this research, undernutrition is analysed and diagnosed on the basis of a $\text{BMI} \leq 18.5 \text{ kg}/\text{m}^2$,

whereas obesity is identified by a $BMI \geq 30$, following WHO (1995). Specifically, the dependent variable Y_i will be evaluated from two perspectives, as specified by Pinho Neto and Berriel (2017):

$Y_i = 1$ if $BMI \leq 18.5$, and $Y_i = 0$ otherwise: this evaluates the impact of BPC on undernutrition.

$Y_i = 1$ if $BMI \geq 30$, and $Y_i = 0$ otherwise: this evaluates the impact of BPC on obesity.

Food security is measured on the basis of the Brazilian Food Insecurity Scale (EBIA). According to IBGE (2020a), EBIA is an adaptation of the scale developed by the United States Department of Agriculture and has been validated by research teams from universities in the five regions of Brazil. The validation process was coordinated by the Department of Public Health of the State University of Campinas (UNICAMP). In Brazil, the EBIA-based method, which uses psychometric scales of household access to food, has the advantage of measuring the phenomenon of food insecurity directly, as perceived by individuals. Thus, relative access to food and the psychosocial dimension of food insecurity are detected. The scale comprises different levels of food insecurity, as summarized in table 1.

Table 1
Brazil: definition of food security and food insecurity levels

Food security status	Description
Food secure	The household has regular and permanent access to quality food, in sufficient quantity, without compromising access to other essential goods and services.
Mild food insecurity	Worry or uncertainty about future access to food; inadequate quality of food resulting from strategies to avoid compromising food quantity.
Moderate food insecurity	Quantitative reduction of food among adults or a break in eating patterns owing to insufficient food among adults.
Severe food insecurity	Quantitative reduction of food also among children; in other words a break in eating patterns owing to insufficient among all household members, including children. In this situation, hunger becomes a lived experience in the household.

Source: Brazilian Institute of Geography and Statistics (IBGE), *Pesquisa de orçamentos familiares 2017–2018: análise da segurança alimentar no Brasil*, Rio de Janeiro, 2020.

The questions that make up EBIA (see table A1.1 in annex A1) and correspond to household self-declarations were included for the first time in the questionnaire evaluating living conditions (POF 6) of the 2017–2018 POF. The EBIA questions are analysed on the basis of a final score gradient, which represents the sum of affirmative responses to the 14 questions. This score establishes cut-off points that are equivalent to the concepts of food and nutrition security and are presented in table 2.

Table 2
Brazil: cut-off points for households without children under 18 years of age, according to food security status

Food security status	Cut-off points
Food-secure	0
Mild food insecurity	1-3
Moderate food insecurity	4-5
Severe food insecurity	6-8

Source: Prepared by the authors, on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Pesquisa de orçamentos familiares 2017–2018: análise da segurança alimentar no Brasil*, Rio de Janeiro, 2020.

Note: Household cut-off points are the scores used to classify households as being food-secure, or subject to mild, moderate or severe or food insecurity.

Nonetheless, as Barret (2002) notes, although the concept of food security is measured at the family or household level, it actually refers to individuals. Therefore, the food and nutrition security indicators of the 2017–2018 POF are used as proxy variables for each level of food security among older persons. Table 3 describes the outcome variables and the observable variables used in the estimations. All variables are recorded in the 2017–2018 POF.

Table 3
Description of the variables used in the model

Outcome variables	Definition
Obesity	Dummy variable indicating whether the older person is obese. Categories: (1) Yes; (0) No.
Undernutrition	Dummy variable indicating whether the older person is malnourished. Categories: (1) Yes; (0) No.
Food safety	Dummy variable indicating whether the older person enjoys food security. Categories: (1) Yes; (0) No.
Mild food insecurity	Dummy variable indicating whether the older person suffers from mild food insecurity. Categories: (1) Yes; (0) No.
Moderate food insecurity	Dummy variable indicating whether the older person suffers from moderate food insecurity. Categories: (1) Yes; (0) No.
Severe food insecurity	Dummy variable indicating whether the older person suffers from severe food insecurity. Categories: (1) Yes; (0) No.
Explanatory variables	
Characteristics of the older person	
Race	Dummy variable indicating whether the older person is white. Categories: (1) Yes; (0) No.
Genre	Dummy variable indicating whether the older person is male. Categories: (1) Yes; (0) No.
Age	Indicates the older person's age in years.
Education	Indicates the older person's years of schooling.
Household characteristics	
Total members	Indicates the total number of household members.
Bath	Dummy variable indicating whether the household has a bathroom. Categories: (1) Yes; (0) No.
Sewerage	Dummy variable indicating whether the household is located near an open sewer or ditch. Categories: (1) Yes; (0) No.
Electric power	Dummy variable indicating whether the electricity used in the household is obtained from the general grid. Categories: (1) Yes; (0) No.
Water	Indicates whether the water used in the household is piped to at least one room. Categories: (1) Yes; (0) No.
Location of home	
Urban area	Dummy variable indicating whether the household is located in an urban area. Categories: (1) Yes; (0) No.
Region ^a	
North Region	Dummy variable indicating whether the household is located in the North Region. Categories: (1) Yes; (0) No.
Southeast Region	Dummy variable indicating whether the household is located in the Southeast Region. Categories: (1) Yes; (0) No.
Midwest Region	Dummy variable indicating whether the household is located in the Centre-west region. Categories: (1) Yes; (0) No.
Southern Region	Dummy variable indicating whether the household is located in the South Region. Categories: (1) Yes; (0) No.

Source: Prepared by the authors, on the basis of M. Ferrario, "Análise do impacto dos programas de transferência de renda sobre as despesas familiares com o consumo", doctoral thesis in science, São Paulo, University of São Paulo, 2013.

^a The Northeast region is the base category.

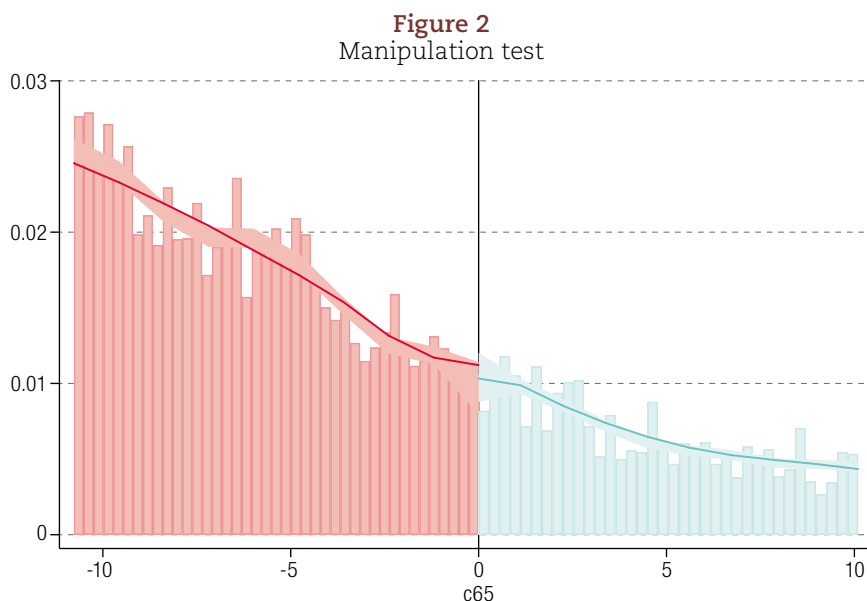
V. Local average effect of BPC on persons in the treatment group

To determine the causal effect, the identification assumptions, such as non-manipulation of the forcing variable, X_i and balanced observable characteristics of the older person, are validated as described in section 1 below. Section 2 describes the results of the local average effect of BPC on the nutritional status and food security levels of older persons in Brazil.

1. Validity of the fuzzy regression discontinuity design

The validity of a regression discontinuity design project requires that units cannot perfectly manipulate the treatment attribution variable (assumption of no manipulation of the forcing variable X_i). According to Cattaneo, Jansson and Ma (2020), the manipulation test is used as a falsification test in empirical regression discontinuity studies.

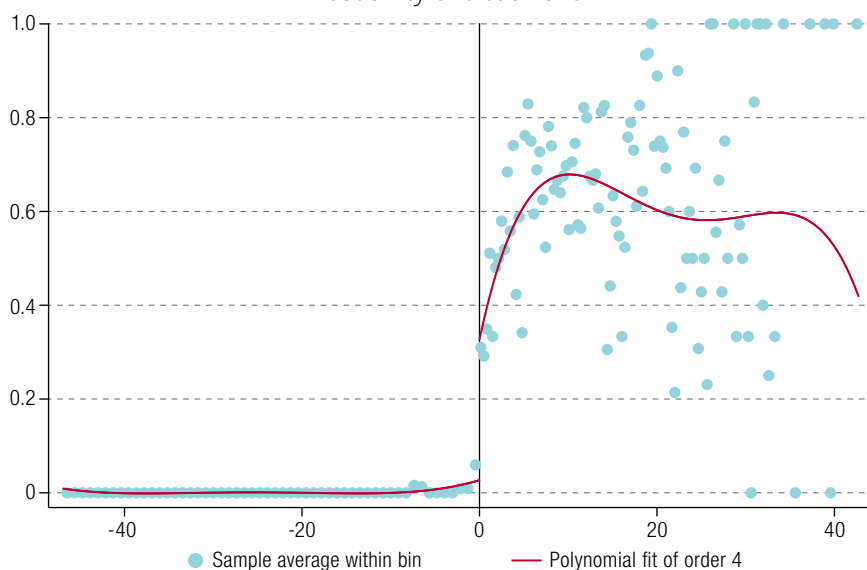
In the present study, the age of the older person is used as an assignment variable to verify empirically whether or not units are able to change their BPC status around the cut-off point, c . As shown in figure 2, the number of observations above the cutoff point is not disproportionate to the number below this threshold. Therefore, according to Cattaneo, Jansson, and Ma (2020), there is no evidence of discontinuous changes around the cut-off point. This means that older persons do not have precise control over the variable, so they cannot manipulate it in order to self-select for treatment.



Source: Prepared by the authors.

In addition to the assumptions used to identify the causal effect, it must be shown that eligibility for treatment is associated with treatment status. Given the eligibility criterion based on the minimum age of 65, which defines receipt of the benefit, older persons who have not reached that age do not receive the treatment, and all older persons who have passed that age should receive it. However, several observable and unobservable factors mean that the change in the older person's probability of treatment is not determined solely by the treatment assignment variable; consequently the probability does not "jump" from 0 to 1 at point c , as seen in figure 3.

Figure 3
Probability of treatment



Source: Prepared by the authors.

Balancing is another identification hypothesis that examines whether or not there are systematic differences between groups — in this case whether older persons just below the cut-off point have observable characteristics that are similar to those of older persons just above the threshold. To verify this hypothesis, tests are performed to gauge whether the means of the characteristics are the same in both groups. Table 4 presents the means of the observable characteristics. The first column reports the means of the observations of untreated persons (without BPC), and the second column shows the observations of those who received the treatment (with BPC). For this test, intervals of +/-5 and +/-8 were used for the age of the older person.

Table 4
Equilibrium of the predetermined characteristics of the older person

Variables	Older persons aged 60–69 years		Older persons aged 57–72 years	
	Without PBC	With BPC	Without PBC	With BPC
Variables of the reference person				
White	0.238	0.291	0.210	0.290***
Man	0.466	0.384	0.455	0.404**
Years of schooling	2.600	3.600	3.350	3.470
Household characteristics				
Bath	0.828	0.963***	0.849	0.959***
Sewerage	0.961	0.989***	0.282	0.452***
Total members	4.600	3.200***	4.673	3.143
Electric power	0.961	0.989	0.970	0.991***
Water	0.609	0.791	0.907	0.956***
Location of home				
Urban area	0.685	0.813***	0.681	0.794***
Region				
North Region	0.304	0.108***	0.228	0.116***
Northeast Region	0.504	0.471	0.553	0.461***
Southeast Region	0.095	0.219***	0.129	0.221***
Centre-west Region	0.057	0.073	0.043	0.066
South Region	0.038	0.126***	0.044	0.133***

Source: Prepared by the authors.

Notes: H_0 : difference between means equals 0; *** and ** indicate 1% and 5% significance levels, respectively.

As shown in table 4, older persons without BPC are statistically different from those with BPC in several characteristics for the sample of older persons aged 57 to 72 years. However, the differences diminish and become non-significant for some of the variables in the age range 60–69 years. In general, as the width of the interval narrows, individuals display similar observable characteristics. However, because some variables show significant differences at the 1% level in the younger age interval, these are included in the regression in order to reduce estimation bias.

2. Impact of BCP on nutritional status and food security levels using the fuzzy regression discontinuity design

The results reported in table 5 show the first and second stages of the estimations. The first stage presents the effect of age on the probability of participating in the programme; and the second stage shows the results of the local average effect of BPC on rates of obesity, undernutrition and food security. The results are estimated using the triangular kernel function and the *cerrd* method to choose the optimal interval, equal on both sides of the cut-off point, as suggested by Calonico, Cattaneo and Farrell (2020).

Table 5
Local average effect of the Continuous Benefit Programme on obesity and undernutrition – fuzzy regression discontinuity design

Specifications	First stage	Second stage
	Obesity	
Triangular <i>Bwmethod = cerrd; h = 5.9</i>	0.18874*** (0.07349)	0.02647 (0.34908)
<i>N(h)</i>	582	
	Undernutrition	
Triangular <i>Bwmethod = cerrd; h = 4.9</i>	0.19327*** (0.08347)	0.04976 (0.20363)
<i>N(h)</i>	457	

Source: Prepared by the authors.

Notes: ***, ** and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors in parentheses. Estimates include controls in respect of older person and household characteristics, and regional dummy variables. *N(h)*: number of observations used for the estimations in each interval.

In the first stage, age is statistically significant at 1%, which means that the age criterion for programme selection is a valid element of impact evaluation. The results of the second stage presented in table 5 show that BPC has no statistically significant effect on obesity or undernutrition.

The results shown in table 6, for the first stage, also reveal that being age-eligible increases the probability of participating in BPC by 25%. This implies that age is an effective eligibility criterion for participation in the programme. The second stage suggests that BPC increased the probability of being food secure by 63% relative to the control group.

Table 6
Local average effect of the Continuous Cash Benefit on food security

Specifications	First stage	Second stage
Triangular <i>Bwmethod = cerrd; h = 7.0</i>	0.25639*** (0.03701)	0.63563*** (0.18418)
<i>N(h)</i>	1 871	

Source: Prepared by the authors.

Notes: ***, ** and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors in parentheses. Estimates include controls in respect of older person and household characteristics, and regional dummy variables. *N(h)*: number of observations used for the estimations in each interval.

The results are similar to those obtained by Bottan, Hoffmann and Vera-Cossio (2021) for households receiving the *Renta Dignidad* pension in the Plurinational State of Bolivia. These authors found that receiving the pension increased the probability that an older person enjoyed food and nutrition security by an average of 0.38 percentage points. Since BPC only affects individual and household incomes, the only transmission channel is through raising of the budget constraint. Thus, families in lower income brackets and with larger reductions in income —even in the event of shocks, such as the COVID-19 pandemic— may respond more strongly to income variations by increasing consumption expenditures, particularly on food (Baker and others, 2020). This finding is supported by Ferrario (2013), in the case of Brazil; and by Case and Deaton (1998), for South Africa; and by Kang, Park and Ahn (2022), who study the case of the Republic of Korea. The pension benefit increases amounts spent on food, improving access to it and, at the same time, increasing its availability and use in the household (Hidrobo and others, 2014; Tiwari and others, 2016).

Table 7 reports the results for mild, moderate and severe food insecurity. The first stage presents the coefficients of the effect of age on levels of food insecurity, which are significant at 1% across all interval specifications. The second stage estimates the coefficients of the local average effect of BPC for all levels of food insecurity. Mild food insecurity shows results that are statistically significant at 1%. In the case of the second stage, the coefficients for moderate and severe food insecurity are not significant.

Table 7
Local average effect of the Continuous Cash Benefit on food insecurity

Specifications	First stage	Second stage
Mild food insecurity		
Triangular <i>Bwmethod</i> = <i>cerrd</i> ; <i>h</i> = 6.4	0.25243*** (0.03895)	-0.68249*** (0.21272)
<i>N(h)</i>		1 679
Moderate food insecurity		
Triangular <i>Bwmethod</i> = <i>cerrd</i> ; <i>h</i> = 5.1	0.24299*** (0.04532)	0.15184 ns (0.21328)
<i>N(h)</i>		1 329
Severe food insecurity		
Triangular <i>Bwmethod</i> = <i>cerrd</i> ; <i>h</i> = 8.7	0.27187*** (0.03313)	-0.02241 ns (0.09923)
<i>N(h)</i>		2 294

Source: Prepared by the authors.

Notes: ***, ** and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors in parentheses. Estimates include controls in respect of older person and household characteristics, and regional dummy variables. *N(h)*: number of observations used for the estimations in each interval.

In poor families, older persons are more likely to have regular, secure and higher incomes than other family members; and BPC may even represent a large proportion of the family income (Bottan, Hoffmann and Vera-Cossio, 2021). The legal and constitutional status of BPC establishes a predictable and regular monthly payment, in accordance with the Organic Act on Social Assistance. Since the benefit is equivalent to one minimum wage, it is adjusted in line with the federal minimum wage, which is estimated to cover the basic needs of Brazilians, such as food and health, among other items. These characteristics make BPC a useful tool for mitigating the socioeconomic effects of the COVID-19 pandemic.

During the pandemic, the federal government used the BPC structure and other social programmes to address the emergency situation. In addition to affecting health, the pandemic had an impact on the economy and, consequently, increased the risk of food insecurity. The necessary physical distancing and quarantine measures had the effect of reducing family income. The Continuous Benefit Programme was used as a tool to address this crisis situation, and several measures were implemented through Act No. 13982 of 2020. These included the relaxation of the family income ceiling for receiving the

benefit — which was raised from a quarter to a half of the per capita minimum wage, taking into account the evaluation of certain vulnerability criteria— and the advance payment of BPC of R\$ 600 to persons who were still in the process of applying to INSS (Paiva and Pinheiro, 2021).

This research supported the analysis of food security levels in the pre-pandemic period 2017–2018. The findings indicate that the BPC income transfer provided protection against food insecurity, especially mild food insecurity (Palmeira and others, 2021). It was particularly important in poor households where the income received by the older person might be the family's only source of sustenance for coping with adverse labour market shocks and rising food prices.

However, it should be noted that ensuring food and nutritional security has become more challenging. Food insecurity is not a recent phenomenon in Brazil (IBGE, 2020a; Pinheiro and others, 2022), but the COVID-19 pandemic increased its levels, as household food security declined and the mild, moderate and severe levels of food insecurity all increased (PENSSAN Network, 2021 and 2022). A number of studies have confirmed that socioeconomic inequalities intensified food and nutrition insecurity during the pandemic, with more severe levels of food insecurity being attained (Pinheiro and others, 2022). According to Boschetti and Rossetti (2021) and Alpino and others (2020), the amounts of income transfers established during the pandemic were well below social needs, which exacerbated social inequalities and probably also worsened the food and nutrition insecurity situation in Brazil.

However, it is also possible that the measures adopted under BPC have had potential for mitigating the effects of the pandemic, by averting poverty among families waiting for the benefit. In addition, the integration of BPC with other social programmes, such as *Auxílio Brasil*, reinforces the anti-poverty strategy, since families can receive both benefits. It has been shown that the *Auxílio Brasil* programme is more effective than BPC in reducing poverty because it costs less, is more precisely targeted to the poor and produces changes in the lives of beneficiaries through the education and health conditionalities. However, BPC targets a population with different needs; for example, older persons and persons with disabilities generate higher costs through their greater demand for health services (Neri and Osorio, 2020). Therefore, in the post-pandemic period, the discussion on BPC should focus on further strengthening of the programme.

VI. Conclusions

Non-contributory pension programmes are being used increasingly to address poverty among older persons in countries such as Brazil. In the non-contributory pension system, the Continuous Benefit Programme (BPC) has proven effective in reducing poverty and inequality, and also influences other poverty-related variables. This research has provided additional information on the impact of BPC on the well-being of older persons, by assessing its effects on obesity, undernutrition, and levels of food and nutrition security, based on microdata sourced from the 2017–2018 POF.

The consideration of unobservable factors showed robust results for the estimations using the fuzzy regression discontinuity method. The main findings are that BPC did not have a statistically significant effect on undernutrition and obesity rates among older persons. However, the programme did have a statistically significant effect on rates of food security and mild food insecurity.

The fact that BPC has not had a statistically significant impact on obesity and undernutrition may indicate that the benefit alone does not improve nutritional status directly. Accordingly, this research suggests promoting policies to improve the monitoring of the nutritional status and health of older persons within the public health system. For example, the programme could play a role similar to that of conditionalities, requiring some economic resources to be channelled into the priority care of older persons. The growth of the older person population poses a challenge to programme coverage, the type of health care and the budgetary resources available. On the supply side, investments, and the upgrading of infrastructure and services needed to meet the demands of the older person, pose challenges for policy makers.

The significant effects of BPC on food security showed that the income transfer enables access to food by easing the budget constraint and thus increasing the availability of food in the household. These results were to be expected, as the benefit affects food consumption directly. However, the findings do not provide information on the nutritional value of the food, in question which requires another type of study. Moreover, the results on food insecurity suggest that it might not be possible to overcome moderate and severe food insecurity with a specific income such as BPC. This has public policy implications that can be carefully integrated into the programme, since the benefit alone is not sufficient to eradicate food insecurity in a specific group of older persons. Nonetheless, it can reduce mild food insecurity, in other words uncertainty about future food consumption among older persons.

This research has a number of shortcomings. The variables used to measure nutritional status are the result of two different measurements in the two most recent POF surveys. This made it impossible to combine the last two surveys to consolidate a larger number of observations for the estimations of nutritional status (obesity and undernutrition).

In addition to the results obtained, suggestions are made for future research that could contribute to the analysis and deepen understanding of the topics studied here: in particular, aspects related to permanency in the programme and heterogeneous effects — according to gender or regions in Brazil, for example.

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Annex A1

Table A1.1
Questions used in the Brazilian Food Insecurity Scale

Number	Question
1	In the last three months, did members of this household have concerns that food would run out before they could buy or receive more?
2	In the last three months, did food run out before the members of this household had money to buy more?
3	In the last three months, did the members of this household run out of money for a healthy and varied diet?
4	In the last three months, did the members of this household eat only a few types of food that they still had because money ran out?
5	In the last three months, did any household member aged 18 years or older miss any meals because there was no money to buy food?
6	In the last three months, did any household member aged 18 years or older ever eat less than he/she felt he/she should because there was no money to buy food?
7	In the last three months, did any household member aged 18 years or older ever feel hungry but did not eat because there was no money to buy food?
8	In the last three months, did any household member aged 18 years or older ever eat once only during the day or go a whole day without eating because there was no money to buy food?
9	In the last three months, did any household member under 18 years of age ever ceased to have a healthy and varied diet because there was no money to buy food?
10	In the last three months, did any household member under 18 years of age ever eat less than he/she should have because there was no money to buy food?
11	In the last three months, was the amount of food in the meals of any household member under 18 years of age ever reduced because there was no money to buy food?
12	In the last three months, did any household member under 18 years of age ever forgo any meals because there was no money to buy food?
13	In the last three months, did any household member under 18 years of age ever feel hungry but did not eat because there was no money to buy food?
14	In the last three months, did any household member under 18 years of age ever eat once only during the day or go a whole day without eating because there was no money to buy food?

Source: Brazilian Institute of Geography and Statistics (IBGE), *Pesquisa de orçamentos familiares 2017–2018: análise da segurança alimentar no Brasil*, Rio de Janeiro, 2020.

Annex A2

Robustness exercise: change of interval and kernel function

Tables A2.1, A2.2, A2.3 and A2.4 present the results with similar intervals on either side of the cut-off, following Imbens and Lemieux (2008). These authors use a uniform kernel function, which gives the same weight to all observations that fall within similar intervals on either side of the threshold, specified as five and eight years.

Table A2.1
Local average effect of the Continuous Benefit Programme on obesity

Specifications	First stage	Second stage
(I) Uniform $h = 5$	0.26771*** (0.0635)	0.04088 ns (0.27397)
$N(h)$		461
(II) Uniform $h = 8$	0.29066*** (0.04762)	-0.08384 ns (0.19422)
$N(h)$		724

Source: Prepared by the authors.

Notes: ***, **and * indicate 1%, 5%, and 10% significance levels, respectively; ns: not significant. Standard errors in parentheses. Estimations I and II include controls in respect of older person and household characteristics, and regional dummy variables.

Table A2.2
Local average effect of the Continuous Benefit Programme on undernutrition

Specifications	First stage	Second stage
(I) Uniform $h = 5$	0.26771*** (0.0635)	0.12626 ns (0.13279)
$N(h)$		461
(II) Uniform $h = 8$	0.29066*** (0.04762)	0.0688 ns (0.09428)
$N(h)$		724

Source: Prepared by the authors.

Notes: ***, **and * indicate 1%, 5% and 10% significance levels, respectively; ns: not significant. Standard errors in parentheses. Estimations I and II include controls in respect of older person and household characteristics, and regional dummy variables.

Table A2.3
Local average effect of the Continuous Benefit Programme on food security, fuzzy regression discontinuity design

Specifications	First stage	Second stage
(I) Uniform $h = 5$	0.30713*** (0.03703)	0.54008 *** (0.16916)
$N(h)$		1 310
(II) Uniform $h = 8$	0.30994*** (0.02788)	0.42161 *** (0.12924)
$N(h)$		2 101

Source: Prepared by the authors.

Notes: ***, **and * indicate 1%, 5% and 10% significance levels, respectively; ns: not significant. Standard errors in parentheses. Estimations I and II include controls in respect of older person and household characteristics, and regional dummy variables.

Table A2.4
Local average effect of the Continuous Benefit Programme on food insecurity

Specifications	First stage	Second stage
Mild food insecurity		
(I) Uniform $h = 5$	0.30713*** (0.03703)	-0.51976*** (0.17713)
N(h)		1 310
(II) Uniform $h = 8$	0.30994*** (0.02788)	-0.33205** (0.13315)
N(h)		2 101
Moderate food insecurity		
(I) Uniform $h = 5$	0.30713*** (0.03703)	-0.0147 ns (0.14173)
N(h)		1 310
(II) Uniform $h = 8$	0.30994*** (0.02788)	0.01866 ns (0.10939)
N(h)		2 101
Severe food insecurity		
(I) Uniform $h = 5$	0.30713*** (0.03703)	-0.00562 ns (0.11047)
N(h)		1 310
(II) Uniform $h = 8$	0.30994*** (0.02788)	-0.10822 ns (0.08551)
N(h)		2 101

Source: Prepared by the authors.

Notes: ***, **and * indicate 1%, 5%, and 10% significance levels, respectively; ns: not significant. Standard errors in parentheses. Estimations I and II include controls in respect of older person and household characteristics, and regional dummy variables.