Cholesterol, hypertension and chronic spine problems: a logit model focusing on rural Brazilian residents in 2013

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Abstract

Background: Over recent decades, Brazil's health indicators have improved; however, access to the country's health services is not homogeneous, with urban areas being better served than rural areas. The general objective of this work is to identify the influence of rural residence and other factors on the incidence of chronic spine problems, hypertension, and elevated levels of cholesterol in Brazil using the last Brazilian National Health Survey (NHS - 2013)) definitions and data. The analysis provided by this study contributes data that can be used to determine the probability of these three conditions occurring in Brazil and identifies the most vulnerable rural groups as defined by diet, physical activity, smoking, and alcohol consumption.

Method: A logit model was estimated to identify the influence of the variables rural residence, sex, age, race, education, health insurance, work, Body Mass Index (BMI), consumption habits, and region of residence on the chronic conditions analyzed.

Results: Results show that rural residents are 5.8% more likely to have chronic spine problems and 0.9% less likely to have hypertension than urban residents. The incidence of all conditions was lower in men than women. The Body Mass Index (BMI) value also influences the chance of having the conditions studied. Individuals with at least a secondary education were less affected by the analyzed conditions than those less educated. There were regional differences in these conditions' incidence, mainly chronic spine problems and hypertension.

Conclusions: The variables BMI, gender, and years of alcohol consumption had significance in all diseases analyzed. To correct underreporting issues, public policies should be directed to expand rural health services. Additionally, actions should be taken to raise the public's awareness of the effects of obesity and alcohol consumption on health.

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Resumo

Introdução: Nas últimas décadas, os indicadores de saúde do Brasil melhoraram; no entanto, o acesso aos serviços de saúde do país não é homogêneo, com maior oferta nas áreas urbanas em relação às áreas rurais. O objetivo geral deste trabalho é identificar a influência do indivíduo residir no meio rural, e outros fatores, na incidência de problemas crônicos da coluna, hipertensão e elevado nível de colesterol no Brasil, usando as definições e os dados da mais recente Pesquisa Nacional de Saúde do Brasil (PNS - 2013). A análise fornecida por este estudo contribui com dados que podem ser utilizados para determinar a probabilidade dessas três condições ocorrerem no Brasil e identifica os grupos rurais mais vulneráveis, conforme características de dieta, atividade física, tabagismo, consumo de álcool.

Método: Estimou-se um modelo de logit para identificar a influência das variáveis residência rural, sexo, idade, raça, educação, plano de saúde, trabalho, Índice de Massa Corporal (IMC), hábitos de consumo e região de residência nas condições crônicas analisadas.

Resultados: Os resultados mostram que os residentes rurais têm 5,8% mais chances de terem problemas crônicos na coluna e 0,9% menos chances de ter hipertensão do que os residentes urbanos. A incidência de todas as condições foi menor nos homens do que nas mulheres. Um maior valor do Índice de Massa Corporal (IMC) aumenta as chances de ter as três condições estudadas. Indivíduos com pelo menos o ensino médio foram menos afetados pelas condições analisadas do que aqueles com menos escolaridade. Havia diferenças regionais na incidência dessas condições, principalmente problemas crônicos de coluna e hipertensão.

Conclusão: As variáveis IMC, sexo e anos de consumo de álcool foram estatisticamente significativas para todas as doenças analisadas. Para corrigir problemas de subnotificação, as políticas públicas devem ser direcionadas para expandir os serviços de saúde rurais. Além disso, devem ser realizadas ações para aumentar a conscientização do público sobre os efeitos da obesidade e do consumo de álcool na saúde.

Palavras-chave: saúde, vulnerabilidades, alimentação, estilo de vida

Introduction

Since the 1940s, Brazil has experienced a demographic change from a predominantly rural to an urban country. Contemporary Brazil has significantly improved education and rural health indicators [1-2]. The country has also seen improvement in the population's economic situation while general societal inequality and the incidence of many health problems have been reduced. Concomitantly, increased income; industrialization and mechanization; urbanization; food availability, including processed foods; and leisure time have led to increased obesity, alcohol consumption, and smoking. These changes have caused a nutritional transition and elevated the population's risk of contracting chronic non-communicable diseases, such as cardiovascular disease, diabetes, cancer and respiratory illnesses [3-5].

In rural areas there is a higher incidence and worsening of conditions of vulnerability regarding poverty and misery. Relative to urban areas, rural areas have worse socioeconomic indicators, more illiteracy, higher infant mortality rates, more evident food insecurity, more limited access to technical assistance, inferior working conditions, and a greater need for access to cash transfer programs. More importantly in the context of the current work, Brazil's rural population also has more difficulty accessing public health and educational services than residents in its urban areas [6, 7].

In a study of health service access inequality between Brazil's urban and rural areas from 1998 to 2008, Arruda et al. [8] highlight factors that that increased rural workers' vulnerability to chronic health issues, among them a lack of access to private health insurance, and that their ages, incomes, and educations handicap them when trying to enroll in available health plans. According to the authors, even when socioeconomic conditions in rural areas equaled those in urban areas, rural individuals have less access to health services. They point out that there is less self-declaration of chronic diseases in rural areas and that this may a reflection of limited health service access. There are also different patterns of use among public and private health users in Brazil, with individuals that have private health plans using more health services [9].

To measure equity in the use of health services in Brazil from 1998 to 2008, Macinko and Lima-Costa [9] analyzed trends in horizontal equity (a hypothesis that people who have the same healthcare needs should have the same access to healthcare services). Their conclusion was that health services improved in Brazil over the analyzed period. The authors note that one of the main factors responsible for this improvement was expansion of the "Family Health Strategy" (FHS) program in 1994. The program offers primary medical and dental healthcare.

According to Escorel et al. [10], primary healthcare is the "gateway" to the health system in that it stresses health needs and acts as a doorway to the system's medical specialties. An FHS team is composed of a doctor, nurse, and local agents who liaise between the community and more specialized service providers, register families and individuals, and accompany them as they negotiate the healthcare system's complexities. Team members must know the health problems and risk situations existing in their community; provide primary care, develop programs to integrate with those responsible for advanced medical care; and promote educational activities related to health problems.

In rural communities in Latin America, it is necessary to expand access to the preventative care services of primary healthcare. By making these services more available, future health problems and the spread of infectious diseases would be minimized and the incidence chronic illness, the impact of aging, healthcare access inequalities, and maternal and child mortality rates would be reduced [14].

The heavy workload and environmental risks inherent in agricultural labor activities combined with concerns arising from harvest uncertainty , a lack of personal protective equipment, and shoddy equipment maintenance contribute to poor health in rural areas [11]. Unfortunately, studies of the rural population are still rarely used in national health diagnoses [1]. Most studies of the rural population focus on productivity, sustainability, family farming, rural violence, and agrarian conflict, not on rural health [7]. Research is needed to aid in the development of appropriate public health policies and effective health programs that positively impact rural residents. It is essential that programs directed toward the rural population are attuned with the rural population's cultural, social and environmental realities [12].

In a study carried out in 174 countries, Scheil-Adlung [13] highlights healthcare access disparities between rural and urban populations. Their research found that an average 56% of the rural population could not access healthcare services, while only 22% of the urban population was in the same predicament. The author draws attention to the lack of healthcare professionals in rural areas and the difference in per capita spending on health, with 2.5 times more being spent on healthcare in urban areas than in rural areas, which results in greater rural suffering and death. A study by Mberu et al. [15] also stresses the difficulties encountered when attempting to access health services in rural areas relative to urban areas.

The general objective of this work is to identify the influence of rural residence and other factors on the incidence of chronic spine problems, hypertension, and elevated levels of cholesterol in Brazil using 2013 Brazilian National Health Survey (NHS) definitions and data. Additionally, the study analyzed physical activity, diet, smoking, alcohol consumption of rural Brazilian residents to identify the most vulnerable groups.

Method

National health surveys are an important source of reliable information to help guide the provision of social and medical services that meet the needs and expectations of the population. Development of the Brazilian National Health Survey (NHS) began in 2009, and the first and only survey was conducted in 2013. The survey is organized by the Brazilian Ministry of Health (MH) and the Brazilian Institute of Geography and Statistics (IBGE) designed to help assess national health policies and programs [16].

This study uses data from 2013 Brazilian National Health Survey (NHS). The NHS is a population-based survey with sampling units determined in three stages. Survey respondents are selected by first dividing the population into sectors, then selecting households in each sector, and finally, asking a single household resident aged 18 or older to complete a questionnaire. The purpose of the sampling process is to ensure the representation of Brazilian macroregions, federation unit, and some metropolitan areas [17]. The next survey is scheduled for 2021.

The NHS contains data on 14 chronic diseases; however, this study focuses on the three chronic conditions with the highest incidence among rural residents, namely: chronic spine problems, high cholesterol, and hypertension[3].

Based on the descriptive analysis of the characteristics of individuals who had one of the three chronic diseases analyzed, a quantitative model was estimated to identify which variables would or would not affect the probability of disease occurrence. The empirical strategy employed was to estimate a logit model[4] by maximum likelihood in which the dependent variable is characterized by the condition of occurrence or not of the disease. The estimated model is presented in Equation 1:

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[3] The NHS considers chronic spine problems, high cholesterol, and hypertension to be diseases rather than conditions and this nomenclature will be applied in the rest of study.
[4] For more details on the logit model, see [27].

$$Disease_j = \alpha + \beta_{1k}characteristics + \beta_{2k}health + + \beta_{3k}region + \beta_{4k}diet + \varepsilon \ (1)$$

in which j represents the disease evaluated, namely: chronic spine problem, high cholesterol, or hypertension; k is the number of explanatory variables included in each of the analysis groups, namely: characteristics; health; region and diet. Descriptions of the variables used in the model are shown in Table 1.

Table 1 Description of the variables used in the model

Group	Variable	Description
Disease	Spine	dummy equal to 1 if the individual has a chronic spine problem and 0 otherwise
	Cholesterol	dummy equal to 1 if the individual has a cholesterol and 0 otherwise
	Hypertension	dummy equal to 1 if the individual has a hypertension and 0 otherwise
Characteristics	Rural	dummy equal to 1 if the individual lives in the rural area and 0 otherwise
	Sex	dummy equal to 1 if the individual is male and 0 otherwise
	age_up_60	dummy equal to 1 if the individual is over 60 years old and 0 otherwise
	White	dummy equal to 1 if the individual is white and 0 otherwise
	Medium	dummy equal to 1 if the individual has at least high school and 0 otherwise
	graduate_post	dummy equal to 1 if the individual has university graduate or postgraduate education and 0 otherwise
Health	BMI	Body Mass Index of the individual
	Insurance	dummy equal to 1 if the individual has health insurance and 0 otherwise
	hard_work	dummy equal to 1 if the individual performs heavy work activity and 0 otherwise
Region	North	dummy equal to 1 if the individual lives at the region North and 0 otherwise
	Northeast	dummy equal to 1 if the individual lives at the region Northeast and 0 otherwise
	South	dummy equal to 1 if the individual lives at the region South and 0 otherwise
	Midwest	dummy equal to 1 if the individual lives at the region Midwest and 0 otherwise
Diet	cons_salad	dummy equal to 1 if the individual consumes salad a least once a week, 0 otherwise
	cons_fish	dummy equal to 1 if the individual consumes fish a least once a week, 0 otherwise
	cons_juice_nat	dummy equal to 1 if individual consumes natural juice a least once a week, 0 otherwise
	cons_snacks	dummy equal to1 if the individual consumes processed snacks a least once a week, 0 otherwise
	anos_drink	Years drinking alcohol
	alcool_week	Number of times you drink alcohol in the week

Related literature frequently considers the variables shown in Table 1 as factors associated with health [6, 7, 18-26].

Results

This section first discusses, the lifestyles, diets, and chronic diseases that characterize rural individuals. Subsequently, the logit models for the three diseases are estimated based on the selected variables.

Food, lifestyle, and chronic diseases of rural Brazilian residents

Thirty-two and two tenths percent of rural survey respondents indicated that they consume an "adequate"[5] amount of vegetables and fruits weekly, 50.8% consume fish weekly; 3.1% replace at least one meal with a sandwich weekly, 13.5% drink soft drinks "regularly"[6], 19.5% consume sweet foods regularly, and 10.5% consider they consume a high amount of salt. All of these percentages are lower than those for urban residents. Additionally, 76.3% of rural residents consume beans regularly, 62.4% drink full fat milk regularly, and 45.8% eat meat or chicken with excess fat weekly. These percentages are higher in rural areas than in urban areas.

Certain eating habits can increase the incidence of chronic, non-communicable diseases over the medium and long terms, especially diseases associated with diet [28]. The health risks accompanying low levels of vegetable and fruit consumption and high levels of meat and milk consumption need to be made clear to Brazil's rural population.

On average 17.9% of the rural population surveyed consume alcoholic beverages at least once a week and start drinking a little earlier (18.4 years) than residents in urban areas (19 years). Rural men start drinking earlier (18 years) than rural women (21 years). Relative to urban areas, a greater proportion of urban residents over 18 years of age drive after drinking (30.4%); and 10.3% of rural residents reported alcohol abuse in the 30 days prior to the survey. Among educational levels, individuals with a complete high school education started drinking alcohol the earliest (17 years), which was the same age as the earliest in the race category: black individuals at age 17. Bertoni & Santos [29] highlight that the pattern of alcohol consumption, the periodicity, and volumes ingested impacts health, accident rates, and violence. The authors also point out that the consumption of alcoholic beverages in rural areas is associated with several religious and cultural traditions, medicinal treatments, and recreation.

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[5] "Adequate" is defined by the NHS following World Health Organization (WHO) recommendations.
[6] "Regular" consumption is found in the NHS results.

Only 13.8% of surveyed rural individuals practice an adequate level of leisure-time physical activity, with the proportion among women being lower (9.6%), and 48.3% declared themselves insufficiently active. Individuals over 60 years performed adequate physical activity the least (4.4%). Individuals with no or incomplete elementary schooling performed adequate physical activity the least (7.9%) in the educational category, as did white individuals (11.8%) in the race category. In their study of physical activity of adults in rural areas in Minas Gerais, Brazil, Bicalho et al. [30} also found low physical activity among rural residents during leisure time, with women being less active than men. The authors note that there is a need for public policies to promote of physical activity in rural Brazil.

On average, rural residents watch 21.4 hours of television per week. Of rural residents over 18 years of age, 17.4% use tobacco products, 16.2% smoke only cigarettes, and 14% of smoke cigarettes daily. The percentages for the three tobacco use variables were higher in rural areas than urban areas.

Regarding the perception of health status, rural residents have a lower proportion of individuals (55.1%) that self-assess their health as good or particularly good when compared with urban residents. Moreira et al. [24] analyzing data from Brazil between 1998 and 2008 highlight that individuals who have agricultural occupations are less likely to declare their health as good. Nery et al. [31] also emphasize that individuals in rural areas have a worse perception of their own health than urban residents.

In rural areas, the incidence of the chronic diseases under study was as follows: 19.8%-hypertension, 4.6%-diabetes, 10%-cholesterol, 3.1%-asthma, 3%-heart disease, 1%-stroke, 6.7%-arthritis or rheumatism, 21.3%- chronic spine problems, 0.9%-WTMD, 5.8%-depression, 5.6%-other mental disorders, 6.3%-sleep problems, 1.2%-cancer, and 1.4%-kidney failure. Among these, only heart diseases, cancer, and kidney failure have a higher incidence in rural men than women, the others have a higher incidence in rural women.

The rural incidence of the disease cholesterol was higher in women (12.8%) than men, in those with no education above elementary school (11.2%) than the more educated, in Caucasians (11.6%) than in other races, and in individuals aged 60 to 64 years (23.2%). Spinal problems affected more women (21.1%) than men, more those with less than a complete elementary school education (25.1%) than the more educated, more black individuals (11.6%) than individuals of other races, and more individuals 75 years of age or over (29.5%). Hypertension was more prevalent in women

(24.7%) than men, in those with less than a complete elementary school education (24.2%), in Caucasians (22.6%), and in individuals 60 to 64 years of age (45.2%)

It is observed that the groups more vulnerable to the diseases that most affect the rural population are comprised by alcohol and tobacco users; individuals that consume an inappropriate diet, especially if they are women; people with little or no education, those over 60 years of age, and both Caucasians and Blacks.

Public policies aiming to reduce the incidence of obesity, smoking, and high-fat meat and alcohol consumption while motivating increased physical activity and the consumption of fruits and vegetables would contribute to improve the Brazilian rural population's health and well-being. The results of these policies are likely to be more effective if they focus on individuals in the lower socioeconomic and educational levels [32].

Logit Model

Table 2 shows the results of the marginal effect from the estimated models. Three estimates were made: chronic spinal problems (1), cholesterol (2) and hypertension (3). The number of observations for each of the models is different given that only individuals who reported a diagnosis of the disease to the NHS survey were considered. All models are statistically significant at the 1% significance level, and the results of the estimations and tests can be seen in Table A1 of the Appendix.

Table 2 Marginal effects from the logical model estimated by the maximum likelihood method on the possibility of disease occurrence

Variable	(1) spine	(2) cholesterol	(3) Hypertension
Rural	0.058***	-0.005	-0.009*
	(0.011)	(0.010)	(0.006)
Sex	-0.099***	-0.017**	-0.013**
	(0.009)	(0.009)	(0.006)
age_up_60	0.124***	-0.017	0.001
	(0.016)	(0.013)	(0.006)
White	0.017**	0.002	-0.006*
	(0.008)	(0.006)	(0.004)
Medium	-0.094***	-0.013*	-0.008**
	(0.010)	(0.008)	(0.004)
graduate_pos	-0.073***	-0.004	-0.011**
	(0.011)	(0.008)	(0.005)
BMI	0.006***	0.005***	0.006***
	(0.001)	(0.002)	(0.002)
Insurance	0.004	0.022**	0.002
	(0.009)	(0.009)	(0.003)

hard_work	0.102***	-0.001	-0.003
	(0.011)	(0.007)	(0.003)
North	0.039***	0.008	-0.006*
	(0.012)	(0.009)	(0.004)
Northeast	0.064***	0.010	-0.013**
	(0.014)	(0.010)	(0.005)
South	0.046***	0.000	-0.001
	(0.013)	(0.008)	(0.004)
Midwest	-0.008	-0.020**	0.005
	(0.013)	(0.009)	(0.005)
Consume_salad	-	0.001	0.002**
	-	(0.001)	(0.001)
Consume_fish	-	0.003	0.001
	-	(0.002)	(0.001)
Consume_juice_nat	-	-0.001	-0.001
	-	(0.001)	(0.001)
Consume_snacks	-	-0.001	-0.001
	-	(0.002)	(0.001)
Years_drinking	-	0.003***	0.003***
	-	(0.001)	(0.001)
Consume alcohol weekly	-	-0.005**	0.000
	-	(0.002)	(0.001)
Observations	27,054	7,543	8,688

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Consumption variables were not included in the chronic spine problem model unlike the cholesterol and hypertension models, because analysis of these variables isn't normally included in literature addressing spine problems, as evidenced in research by [18, 20, 21, 22, 33, 34, 35, 36, 37, 38, and 39].

Chronic spine problems

Rural area residents were 5.8% more likely to have a chronic spine problem than urban residents. This fact can be associated with activities that involve strenuous physical activity, addressed by the variable "hard_work." When performing such activities, the probability of disease occurrence increases by 10.2%. This corresponds with works by [20, 21, 33] that highlight the impacts of work activity on the incidence of spinal problems.

The dummy variable that indicates individuals over 60 years of age showed a positive, statistically significant chronic spine problem result. Those over 60 years of age were 12.4% more likely to have chronic spine problems than younger individuals, which corroborated works by [33, 34] emphasizing the effect age has on the incidence of chronic health problems.

BMI was also positively related with chronic spine problems. A 10% increase in the index average, increased the likelihood of being affected with this issue by 6%, a result that supports studies

relating obesity with low back pain, such as [35-37]. The latter article also highlights that obesity can be considered a predisposing factor for other health problems, such as hypertension, cardiovascular disease, respiratory disorder and osteoarticular disorder. The study by Smuck et al. [38] underscores the importance of physical activity to reduce obesity and lower back pain. Caucasian respondents were 1.7% more likely to suffer spine problems than people of other races, a result consistent with that from Santos et al. [39].

The incidence of chronic spine problem was less likely for men than women, was less likely for the more highly educated than the less educated, and less likely for residents in Brazil's Southeast region than for residents of other regions. The gender result that men were 9.9% less likely to be affected by chronic spine problems than women could be due to underreporting, since many men are imbued with the notion that men do not get sick and are therefore reluctant report physical weakness [40,41]. Individuals with a secondary and higher education were 9.4% and 7.3% less likely to suffer spinal problems, respectively, when compared to those who did not advance beyond elementary school. Residents of Brazil's Southwest region were less likely to be affected by spine problems than those living in the country's North, Northeast and South regions by 3.9%, 6.4% and 4.6%, respectively.

Cholesterol

Certain eating habits increase the incidence of chronic non-communicable diseases over the medium or long terms [26]. It is generally accepted that cholesterol levels and hypertension, both defined as diseases by the Brazilian Ministry of Health, are factors that contribute to cardio vascular and heart disease.

For cholesterol, the rural variable is not statistically significant, which indicates that whether the individual lives in a rural or urban area is not significant to explain the probability of having this chronic disease.

Relative to women, men have a 1.7% smaller probability of being diagnosed with this cholesterol, which again may be related to underreporting. As has been mentioned, men are often reluctant to admit health problems and could be even more reluctant to make use of preventative health services to diagnose often symptomless diseases, such as high cholesterol [41, 42]. Among

survey participants, the proportion of men over 18 years of age who never had their cholesterol level measured (33.8%) is greater than that of women (18.2%).

A 10% increase in average BMI led to a 5% increase in the chance being diagnosed with high cholesterol. Individuals with health insurance have a 2.2% greater chance having high cholesterol than the uninsured. This result contradicts the result from Barros et al. [43] that there was a higher incidence of chronic diseases among the uninsured population than the insured. A possible explanation for this result is that individuals with health insurance had more examinations and medical consultations than the uninsured, which would result in more disease identification.

Individuals with at least secondary school education have a 1.3% lower chance of being diagnosed with high cholesterol than those that did not advance beyond elementary school, which is in accordance with results obtained by [8, 43]. Individuals that are more educated may be more aware of the dangers of chronic disease and schedule more medical tests.

The possibility of being diagnosed with high cholesterol increases by 0.3% every year an individual consumes alcohol, but falls 0.5% if the individual drinks at least twice a week. Possible explanations for this contra-intuitive result could be that having been diagnosed with cholesterol, individuals then reduce their intake of alcoholic beverages or that heavy drinkers eat less, especially less high cholesterol foods.

Living in the Brazil's midwestern regions reduces the chance of having high cholesterol by 2%, compared to residents of the country's Southeast region.

Hypertension

Individuals residing in rural areas are 0.9% less likely to be diagnosed with hypertension than urban residents. Relative to residents in Brazil's Southeast region, residents in the Brazil's North and Northeast regions less likely less likely to be diagnosed with hypertension by 0.6% and 1.3%, respectively.

According to the estimated model, being male reduces the probability of having this disease by 1.3%. As with cholesterol, the proportion of men over 18 years of age who have never had their blood pressure measured was higher (8.1%) than for women (3.1%). This may be one of the reasons why a lower proportion of men have hypertension than women since there is less measurement, consequently less possibility of identifying the disease. This result is consistent with literature that notes a higher incidence of chronic diseases among women, possibly because women are more

attentive to disease symptoms and use health services more often, which results in more disease diagnoses [43].

Being Caucasian reduces the chance of hypertension by 0.6% over other races, similar to the result from Mainous et al. [44]. Relative to those with less than a high school education, individuals with a high school education have an 0.8% smaller chance of contracting the disease and those that moved on to higher education have a 1.1% smaller chance, This result corroborates those from the study by Beltrán-Sánchez and Andrade [32] analyzing the chronic diseases trend in Brazil from 1998 to 2013 based on educational inequalities. Their study shows that individuals with little or no education had higher levels of hypertension than those more educated.

Salad consumption increases the chance of hypertension by 0.2%. A possible explanation for this result could be that individuals diagnosed with the disease increase their consumption of salad after the diagnosis.

Additional results show that a 10% increase in mean BMI increases the chance of having hypertension by 6%, corroborating works by [45-48]; and for each additional year that an individual consumes alcohol, the chance of reporting a diagnosis of hypertension increases 0.3%.

Conclusion

The variable gender was statistically significant in all the study's models. Women were more likely to have been diagnosed with high cholesterol, hypertension, or suffer chronic back pain, a result that may be due to underreporting errors since a greater proportion of men than women were found to have never undergone basic medical testing, such as for cholesterol and hypertension, or availed themselves of other healthcare services. Relative to the urban population, the rural population in general was found to have a higher rate of individuals that have never been tested for cholesterol or hypertension. Efforts should be made to resolve this seemingly intractable reality.

The variables BMI and years drinking alcoholic beverages were also statistically significant in all the study's models. The implementation of educational programs that focus on reducing obesity and alcohol consumption would contribute to reduce the occurrence of the three analyzed chronic diseases. These programs should also address the negative health ramifications of elevated high-fat meat and milk consumption and low fruit and vegetable consumption. Designers of health related programs intended to improve the entire Brazilian population's wellbeing must remain cognizant of the

many differences between the rural and urban populations, especially in regards to education and value-systems.

Since the last NHS was in 2013, the present research is limited by a data gap; and as the number of variables increased, as many of the variables showed missing values... It is also important to note that because the data are cross sectional, characteristics of unobservable individuals cannot be controlled for and bias can be generated. Despite these limitations, the present research contributes to discussions centered on the connections between eating habits, lifestyles, and chronic diseases, especially if the discussion is focused on the Brazilian rural environment. The results of this study should be of assistance in the design of social programs that effectively mitigate rural health problems.

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APPENDIX

Table A1 Logit models estimated by maximum likelihood on the probability of selected disease occurrence

Variable	(1) spine	(2) cholesterol	(3) hypertension
rural	0.267***	-0.061	-0.212*
	(0.048)	(0.129)	(0.116)
sex	-0.417***	-0.216***	-0.291***
	(0.035)	(0.082)	(0.079)
age_up_60	0.617***	-0.213	0.019
	(0.060)	(0.157)	(0.147)
white	0.075**	0.028	-0.144*
	(0.038)	(0.082)	(0.075)
medium	-0.397***	-0.167*	-0.186**
	(0.043)	(0.099)	(0.086)
graduate_post	-0.311***	-0.049	-0.236**
	(0.047)	(0.106)	(0.097)
BMI	0.025***	0.071***	0.142***
	(0.003)	(0.007)	(0.008)
insurance	0.019	0.351***	0.059
	(0.040)	(0.084)	(0.077)
hard_work	0.496***	-0.019	-0.064
	(0.040)	(0.089)	(0.081)
North	0.177***	0.117	-0.146
	(0.049)	(0.105)	(0.098)
Northeast	0.297***	0.149	-0.291**
	(0.053)	(0.123)	(0.120)
South	0.213***	0.001	-0.037
	(0.056)	(0.111)	(0.105)
Midwest	-0.036	-0.245**	0.146
	(0.059)	(0.123)	(0.102)
cons_salad	-	0.014	0.042***
	-	(0.016)	(0.014)
cons_fish	-	0.047*	0.014
	-	(0.027)	(0.027)
cons_juice_nat	-	-0.018	-0.028**
	-	(0.015)	(0.014)
cons_snacks	-	-0.020	-0.026
	-	(0.022)	(0.020)
anos_drink	-	0.045***	0.062***
	-	(0.004)	(0.004)
alcool_week	-	-0.067***	0.009
	-	(0.024)	(0.021)
Constant	-2.279***	-4.756***	-6.711***
	(0.107)	(0.260)	(0.268)
Wald chi2	645.84***	378.88***	824.57***
Pseudo R2	0.0272	0.0653	0.1490
Observations	27,054	7,543	8,688

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1