IOSR Journal of Nursing and Health Science (IOSR-JNHS)
e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 13, Issue 5 Ser.1 (Sept. – Oct. 2024), PP 45-50
www.iosrjournals.org

Impact Of State Expenditures On The Increase In Life Expectancy In Brazil

Helena Peres Peres Nunes
Ricardo Da Costa Nunes
Medical School, Centro Universitário –Unieuro, Brasil
Ministry Of Finance, Brasil

Abstract:
This study analyses the impact of state public health expenditure on life expectancy in Brazil between 1990 and 2021, focusing on how investments in the health sector influence the population's longevity. The research uses a panel data model to explore the correlation between health spending and life expectancy, considering per capita income as a secondary variable. The results show a significant positive relationship between increased health spending and improvements in life expectancy across Brazilian states. However, another relevant finding indicates that health spending has become insufficient to significantly boost life expectancy, possibly due to rising healthcare costs driven by an ageing population. This ageing has generated increasing pressure for more health resources, requiring expanded expenditure in this sector. This study aims to contribute to the debate on the effectiveness of state health policies and encourages future investigations into optimising public health investments to maximise benefits for the population.

Key Word*: Health expenditures; life expectancy; ageing population; Panel data analysis; Healthcare costs.*

Date of submission: 05-09-2024 Date of acceptance: 15-09-2024

I. Introduction

Life expectancy is recognised as one of the key indicators for assessing a population's well-being. In Brazil, the significant increase in longevity over the past decades has been driven by various factors, among which the role of public health investments stands out. State health policies, represented by specific budget allocations for public health services and programmes, are important in improving these indicators.

Given this context, this study examines how state health expenditures have impacted the life expectancy of the Brazilian population between 1990 and 2021. Using a panel data model, the study seeks to understand the correlation between state investments and the increase in longevity, also considering per capita income as an additional variable. Given Brazil's demographic transition, where an ageing population places increasing pressure on the healthcare system with a growing demand for medium- and high-complexity services, exploring the effectiveness of public health spending in this sector becomes even more relevant.

The main objective of this study is to provide empirical evidence that can contribute to the debate on the effectiveness of state public health policies and assess whether the increase in expenditures has been sufficient to keep pace with the ageing population and improve the quality of life of Brazilians. The research thus aims not only to identify the relationships between spending and life expectancy but also to encourage a discussion on possible adjustments in budget allocations to maximise public health benefits.

It should be noted that this study will be limited to assessing the impact of state spending on the life expectancy of Brazilians, aiming to understand how investments made by states in public health directly influence the longevity of the population. The analysis will focus on the correlation between the resources allocated by the states to health services and the improvement in life expectancy indicators over the years. The impact of state financial data and per capita income will be evaluated, considering the effect of these expenditures on increasing life expectancy. This study will contribute to identifying whether state spending has increased the life expectancy of their inhabitants, providing input for the debate on the effectiveness of state public health policies.

The article is organised into six main sections: the Introduction, which contextualises the impact of state public health expenditures on life expectancy in Brazil; the Health Financing System, which details the tripartite funding structure and resource allocation mechanisms; the section on Demographic Transition in Brazil, which explores the challenges posed by an ageing population to the healthcare system; the Methodology, which outlines the use of panel data models and statistical tests; the Results section, which presents the findings, including the correction of statistical issues such as autocorrelation and heteroscedasticity; and, finally, the Conclusion, which

synthesises the implications of the results and suggests the need for an expansion of public health investments, given the ageing population.

II. Health Financing System

Health financing in Brazil is carried out through a tripartite system involving the federal government, states, and municipalities. All of these are required to allocate a minimum percentage of their revenue to health services. These resources are directed to the State Health Fund. This fund is established by law and regulated by the states themselves, functioning as a budgetary and managing unit for resources aimed at public health actions and services, except for those funds transferred directly to units linked to the Department of Health.

To regulate this financing structure, the Federal Constitution and complementary laws, such as Constitutional Amendment No. 86/2015 and Complementary Law No. 141/2012, establish the configuration of the Health Fund and the guidelines for spending. These regulations determine that the Union must allocate at least 15% and 12% of its net current revenue from a basket of taxes to health funding. It is important to highlight that only the resources defined within this basket of revenues managed through the Health Fund are accounted for when calculating the constitutional minimum.

In addition to state resources, health funding also includes intergovernmental transfers from the SUS (Unified Health System), which can occur through two modalities: agreements and fund-to-fund transfers. Agreements are specific arrangements between the federal government and state or municipal governments, with purposes defined on a case-by-case basis and governed by their own rules. These transfers are voluntary, linked to pre-established activities, and may or may not require a counterpart contribution from the receiving government entity.

Fund-to-fund transfers, carried out by the National Health Fund, are automatic transfers to state and municipal health funds, as stated in Article 18 of Complementary Law No. 141/2012. These resources are allocated for operating and capital expenses related to public health actions and services without needing agreements or other legal instruments. They are directly accounted for in the health funds, contributing to the fulfilment of constitutional funding targets.

Fund-to-fund transfers can be classified into four main categories:

- Expanded Basic Care Fixed Floor: This fund is allocated for primary healthcare, covering tuberculosis control, hypertension, diabetes, leprosy elimination, and oral, maternal, and child health programmes. These transfers are mandatory and exclusive to these programmes, and the amount is calculated on a per capita basis for each state and municipality.
- Variable Basic Care Floor: Resources from this category are designated for the development of specific programmes such as the provision of basic medicines, tackling nutritional deficiencies, community health agents, and the Family Health Programme. The transfer is mandatory and conditional, with the total amount dependent on each programme's production level or coverage. This showcases its adaptability to varying healthcare needs, capped at a limit for each state or municipality.
- Health Surveillance and Epidemiological Control: The coverage and/or production of health surveillance and epidemiological programmes determine the total amount transferred, up to a limit defined for each federative unit, underlining the critical role of this category in maintaining public health.Medium and High Complexity Procedures: These resources are allocated for more advanced outpatient and hospital care, including surgeries and the distribution of exceptional medicines for chronic patients. This transfer is mandatory, conditional, and based on production, subject to a resource ceiling per state or municipality. As institutions capable of providing high-complexity care are concentrated in certain more developed municipalities and states, there is a need to compensate these subnational units for attending to patients from other regions.

In addition to these categories, Pharmaceutical Assistance is relevant in ensuring that the population can access essential medicines for maintaining health. The resources allocated to this area come from the federal government, which regularly transfers them to states and municipalities by established guidelines and regulations. These transfers ensure that indispensable medicines are available in public health units, contributing to the effective delivery of healthcare services and improving public health indicators in Brazil.

III. The Demographic Transition In Brazil: Impacts Of Ageing On Public Health

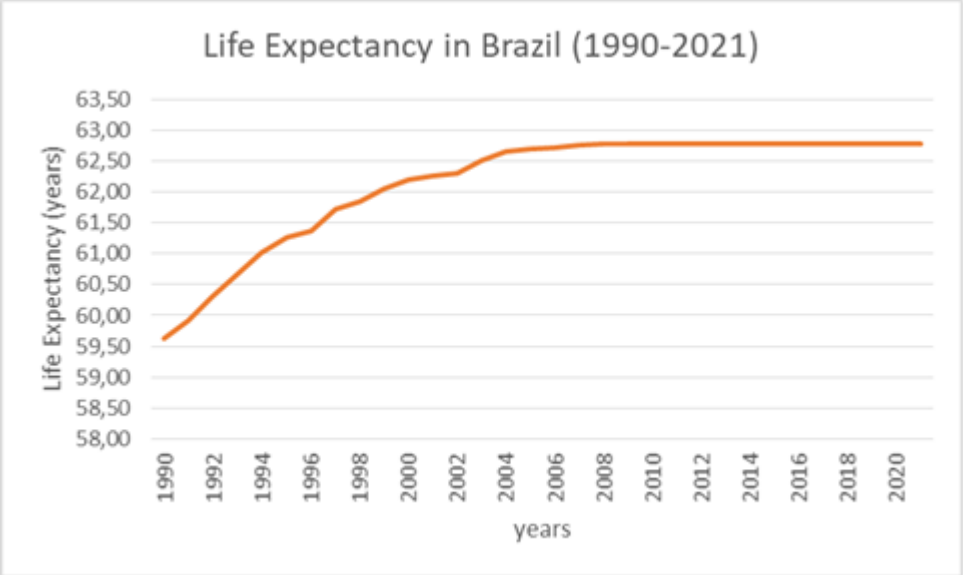
Population ageing reduces the effectiveness of health policies. This finding is because, as the population ages, the demand for health services, particularly for medium and high-complexity treatments, increases, requiring growing public resources. The demographic transition currently underway in Brazil, characterised by a rapid increase in the elderly population and a decline in fertility rates, places increasing pressure on the health system to meet the specific needs of this age group. The elderly require more continuous medical care, treatments for chronic diseases, hospital care, and medications, resulting in more significant public health expenditures. In other words, population ageing demands that the resources from the Health Fund, including fund-to-fund transfers and

allocations to the Pharmaceutical Assistance Programme, be expanded and optimised to ensure adequate access to health services for the elderly. Programmes such as those for Medium and High Complexity Procedures and Health Surveillance are especially important, as they address the growing demand for specialised care, such as surgeries and treatments for chronic diseases, which are common in an ageing population.

The proportion of the population over sixty is growing faster than any other age group. Historically, the number of children has always been higher than that of older adults. However, by 2030, it is expected that the percentage of the population in Brazil aged over sixty will surpass the percentage of young people aged up to fourteen. The proportion of the elderly population (over sixty) is increasing, while the proportion of young people (aged zero to fourteen) and adults (aged fifteen to sixty) is decreasing.

Two key factors explain population ageing: the increase in life expectancy and the decline in fertility rates. This reduction is primarily linked to changes in the population's demographic profile resulting from the progressive decrease in fertility rates.

The success of healthcare spending implementation can be observed in Brazil's life expectancy increase. According to the IBGE (2023), the life expectancy of Brazilians rose from approximately 59.63 years in 1990 to around 62.78 years in 2021. This increase in the average age of Brazilians is reflected in the slower growth in life expectancy from 2006 onwards. This success in health policy leads to additional rising expenditures due to the population's increased life expectancy. A larger elderly population requires a higher demand for medical care nationwide. The significant and constant increase in healthcare spending may explain the slower growth in Brazilian longevity after 2004. This evolution can be observed in the following chart.



Source: Instituto Brasileiro de Geografia e Estatística (IBGE), data compiled by the authors..

The significant growth in healthcare spending has been constant, reinforcing the importance of strategic investments in the sector. In addition to the direct impacts on life expectancy, there is an economic motivation for investing in healthcare. Health investments can contribute to increased labour productivity, as Rezende and Dain (1985) noted. This rise in productivity would contribute to increased income and, consequently, higher tax revenues. Priority should be given to preventive healthcare. The importance of healthcare spending is emphasised by the IMF (1996), which states that increased healthcare spending, when well allocated, boosts private sector productivity.

IV. Methodology

Choice of indicators

Given the trade-off between sample size and the number of indicators, only the essential variables for monitoring public policy were used. However, the number of indicators is sufficient to achieve the objectives. Selecting one outcome indicator and another effort indicator contributed to meeting these goals.

As a result, one indicator was presented to measure the health and well-being of the population and another to assess health progress. These indicators evaluate the effectiveness of the health policy intervention. In the literature, these are classified as outcome indicators. The indicator (long) is a proxy for the population’s health well-being, as the desired outcome of public health policy is improving public health.

Panel data model

The panel data model can be conceptualised using longitudinal data over time with a dependent variable and explanatory variables. In our study, life expectancy is the dependent variable, while healthcare expenditure and per capita income are the independent variables for 1990-2021. Montenegro, Diniz, and Simões (2014) argue that in this case, there is much more information available to study the phenomenon, along with additional degrees of freedom.

The main advantage of regressions with panel data, which combine the cross-sectional and longitudinal dimensions, is the ability to model unobserved heterogeneity (also known as fixed effects), representing, for instance, temporally stable characteristics related to the nature of economic activity or the quality of management. Reducing the endogeneity arising from omitted variables is possible by eliminating the observational units' unobserved heterogeneity. However, for this to be effective, the model must be consistent. However, the consistency of the estimator depends on the absence of correlation between the explanatory variables and the model's error term at any point in time. The consistency of any estimator relies on the validity of the assumptions underlying it.

This section presents the statistical treatment of the empirical research on public health policy to conduct an impact assessment based on convincing scientific evidence. This analysis includes an examination of compliance with the statistical criteria required by the panel data model. Thus, the linearity of the relationship between the variables is examined, i.e., whether the error variance terms are constant, whether there is independence among the values of the predictor (explanatory) variables, and whether the model's equation was adequately specified to avoid the formation of endogeneity. The endogeneity of the regressors makes the estimators inconsistent and results in inadequate inferences.

These problems arise from omitted variables, measurement errors in the variables included in the model, and/or simultaneity between dependent and independent variables. To ensure these criteria are met, the data collection process is examined to avoid forming a biased sample, and the indicators are selected to measure the results of educational expenditure to specify the explanatory variables properly. It is also verified whether the panel data meets the assumptions required by econometric theory. Additionally, to ensure that the impact of over-expenditure on primary education on the quality of education and the growth of municipal GDPs is not a spurious relationship, the relationship between the explained and explanatory variables is grounded in microeconomic theory. Guaranteeing the statistical relationship also requires that the estimated parameters are unbiased, consistent, and efficient.

This study seeks to reduce concerns about bias by using a long-period sample covering the years 1990 to 2021. This breadth contributes to the representativeness of the population. In such cases, the probability distributions of the least squares estimators tend to concentrate around the true parameters, Hill, Griffiths, and Judge (1999).

Stationarity and absence of autocorrelation of the errors

The Im-Pesaran-Shin (IPS) unit root test for panel data was conducted to assess the stationarity of the time series used in this study. This test allows us to verify whether the time series are stationary, meaning whether they have a trend over time that could influence the conclusions of the regression models. The IPS test was applied to the dependent variable "long" (longevity), considering lags of 1 period. The IPS test is suitable for unbalanced panels, like the one used in this study, as some time series have different numbers of observations.

The null hypothesis of the IPS test assumes that all series contain a unit root (are non-stationary), while the alternative hypothesis is that at least some of the series are stationary. The next step was to identify the most appropriate model to use, among those listed by Wooldridge (2010), that best explains the influence of the independent variables on life expectancy (dependent variable). These models include pooled fixed effects and random effects. The identification of the model for each panel dataset depends on the characteristics of the data.

The pooling model is similar to the ordinary least squares estimator used in multiple linear regression, as discussed by Baltagi (2005) and Schuh et al. (2017). The feature that makes the application of this model possible in this study is the validity of the assumption that there are no unique attributes for each state nor effects that change over time. Statistically, this condition translates into the covariances between the identity dummies and the explanatory variables equal to zero.

Homoscedasticity is also necessary to obtain reliable statistical results. In other words, if heteroscedasticity had been found, the confidence intervals and t and F hypothesis tests would have yielded inaccurate results due to the standard error, and the inferences would have been incorrect.

The panel data model estimates, including the expenditures made by state i at time t to improve education, showed statistical significance at the 1% level. Empirically, we estimated equation (1), where the dependent variable is life expectancy in each state, to test the study's hypothesis.

In light of this, the present study estimates the following equation using panel data and the associated hypothesis. The hypothesis that state healthcare expenditure explains the increase in the life expectancy of the state's population is tested in the following equation:

$$long_t^i = \beta_0 + \beta_1\, desps_t^i + \beta_2 despK_t^i \qquad (1)$$

Hypothesis:

$\beta_1 > 0$, healthcare expenditure increased the population's life expectancy in the states.

Where,

- long is the life expectancy of state i in period t, as reported by the IBGE. It is the dependent variable;
- desps is the healthcare expenditure of state i in period t; and
- despK is the per capita income in state i in period t.

Equation (1) is tested using panel data. Equation (1) seeks to determine to what extent state healthcare expenditure explains the increase in life expectancy of the state's population. This test has life expectancy as the dependent variable and healthcare expenditure and per capita income as the explanatory variables. The aim is to describe the relationship between healthcare expenditure and the growth in life expectancy.

V. Results

The general test results indicated a Wtbar statistic of -7.332, with a p-value of 0, suggesting that the null hypothesis of a unit root can be rejected for all series with 1% confidence. This finding means that, overall, the series analysed are stationary.

Stationarity was confirmed for the series related to grades, education, GDP, and residuals. Thus, it can be affirmed that these series exhibit constant mean and variance over time, and the autocorrelation structure has not changed. Therefore, the presumption of spurious regression, which could occur if the series were correlated solely because they grew simultaneously over time, was discarded.

The panel data regressions did not allow for the rejection of the hypothesis. This result indicates that healthcare expenditure increased citizens' life expectancy, as the study's hypothesis predicted. The hypothesis that healthcare expenditure increased life expectancy was also not rejected with the application of the panel data.

The signs of the coefficients were consistent in all models despite the different model assumptions. The most appropriate model was determined after conducting tests. The F-test for individual effects was used to choose between pooled OLS and fixed effects, while the Breusch-Pagan test was applied to compare pooled OLS and random effects. The choice between fixed and random effects was made using the Hausman test.

Final Results of the Tests and Adjusted Models:

Fixed Effects Model:

The model was adjusted using the formula: long ~ desps + despK.

The coefficient for desps was significant (p-value < 2e-16) and positive, indicating a positive and significant relationship between expenditures and the dependent variable long. The coefficient for despK was not statistically significant at the 5% level (p-value = 0.2292) but showed marginal significance at the 10% level in the robust model.

Hausman Test:

The test compared the fixed and random effects models. The p-value of 0.3253 indicated insufficient evidence to reject the random effects model, suggesting that both models are consistent.

Autocorrelation Test (Wooldridge):

The Wooldridge test detected serial autocorrelation in the residuals, with a p-value < 2.2e-16.

Given the detection of autocorrelation, it was necessary to correct the model.

Heteroscedasticity Test (Breusch-Pagan):

The test indicated a p-value of 0.07131, suggesting no significant evidence of heteroscedasticity at the 5% level but possibly marginal at the 10% level.

Model with Robust Standard Errors (Arellano):

The model was adjusted using robust standard errors to correct for heteroscedasticity and autocorrelation issues. After the correction, the coefficients were as follows:

- desps: A significant coefficient with a very low p-value (1.013e-08), indicating a positive and significant effect of desps on long.
- despK: A marginally significant coefficient (p-value = 0.07453), suggesting a small positive effect of despK on long, though this effect is less robust.

The Hausman test was employed to select between fixed and random effects models. The test results did not provide sufficient evidence to reject the null hypothesis, indicating that the fixed and random effects models are consistent. This finding suggests that either model could be appropriate for the data, with the random effects model potentially offering greater efficiency.

Further, diagnostic tests were conducted to check for issues of autocorrelation and heteroscedasticity. The Wooldridge test for autocorrelation detected serial correlation in the residuals, while the Breusch-Pagan test for heteroscedasticity indicated marginal evidence of heteroscedasticity at the 10% significance level. Robust standard errors were employed to address these issues, correcting for the detected autocorrelation and heteroscedasticity and ensuring the estimates remained reliable.

Given that the model adjustments successfully accounted for these issues and there is no significant evidence of correlation between the regressors and the error term, we can reasonably infer that endogeneity is not present. Consequently, based on the results of these tests and corrections, there is no significant indication of endogeneity in the model, further strengthening the validity of the findings.

VI. Conclusion

This study demonstrated that state healthcare expenditures significantly influence life expectancy in Brazil. The application of panel data models consistently shows that increased healthcare spending is positively associated with longevity, particularly the variable deeps, which represents direct health expenditures. Although the role of per capita income (despK) was less robust, it still showed a marginally positive effect on longevity.

The analysis confirms that, despite the challenges posed by an ageing population and the growing demand for more complex healthcare services, allocating public resources to health has a tangible impact on improving public health indicators. The rejection of the null hypothesis regarding the effect of healthcare spending on life expectancy strengthens the argument for continued investment in the healthcare sector by state governments.

Additionally, the methodological rigour, including autocorrelation and heteroscedasticity tests, ensured the robustness of the results. The adoption of models with robust standard errors addressed potential issues in the data, providing reliable estimates.

This work contributes to the ongoing debate on how best to allocate public resources in the face of demographic transitions, providing evidence that adequate investments in public health are essential for improving the population's overall well-being. Future research could explore in more detail the specific mechanisms by which healthcare spending increases longevity and investigate regional variations in these outcomes.

Future studies could also investigate the cause of the slowdown in the increase in life expectancy after 2004. These studies should assess whether there is a need to increase the allocation of resources to healthcare or improve the efficiency of public spending in the sector.

References

[1]. Baltagi, B. H. (2005). Econometric Analysis Of Panel Data (3rd Ed.). John Wiley & Sons.Schumpeter, Joseph A. (1964) História Da Análise Econômica. RJ/SP, Editora Fundo De Cultura, Vol. 2, Parte II, Cap. 7.
[2]. Hill, R. C; Griffiths, W. E.; Judge, G. G. (1999). Econometria. São Paulo: Saraiva.
[3]. Instituto Brasileiro De Geografia E Estatística (IBGE). (2023). Tábuas Completas De Mortalidade Para O Brasil – 2022: Breve Análise Da Evolução Da Mortalidade No Brasil. Retrieved On 13 June 2024, From Https://Www.Ibge.Gov.Br/Estatisticas/Sociais/Populacao/9126-Tabuas-Completas-De-Mortalidade.Html .
[4]. International Monetary Fund (1996). World Economic Outlook (1996). Washington, D.C.
[5]. Montenegro, R. L. G., Diniz, B. P. C., & Simões, R. F. (2014). Ciência E Tecnologia Versus Estruturas Estaduais: Uma Análise Em Dados Em Painel (2000-2010). Anais Do XLII Encontro Nacional De Economia. ANPEC-Associação Nacional Dos Centros De Pós-Graduação Em Economia.
[6]. Rezende F. & Dain S. (1985). Reforma Institucional, Finanzas Públicas Y Control De Los Gastos Governamentales. Pesquisa De Planeamiento Económico - PPE. Revista Del Instituto De Planeamiento Económico Y Social-IPEA.
[7]. Schuh, A., Sereinigg, M., Mehta, A., & Steininger, K. (2017). Economic Analysis Of Panel Data In Transportation Research. Transportation Research Part A: Policy And Practice, 100, 102-115.
[8]. Wooldridge, J. M. (2010). Econometric Analysis Of Cross Section And Panel Data. MIT Press.