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FIRST FATHERHOOD IN BRAZIL: A COMPARATIVE ANALYSIS OF SOCIODEMOGRAPHIC DETERMINANTS BETWEEN CITY AND COUNTRY MEN

Primeira paternidade no Brasil: Uma análise comparativa dos determinantes sociodemográficos entre homens da cidade e do campo

Primera paternidad en Brasil: Un análisis comparativo de los determinantes sociodemográficos entre hombres de ciudad y de campo

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ABSTRACT

This study examines how sociodemographic factors influence the decision to become a father for the first time among urban and rural men in Brazil. Using data from the 2019 National Health Survey and applying Kaplan-Meier and Cox survival analysis models, the objective is to identify and compare the determinants that affect this decision in different geographic contexts. The methodology included a detailed analysis of sociodemographic, economic, and health variables, as well as the use of social media. The results indicate that men in rural areas tend to become fathers earlier, influenced by lower levels of education, while in urban areas, higher education tends to delay fatherhood. Factors such as race and geographic region are also significant: black men and those residing in the North and Northeast show a greater likelihood of early fatherhood. The risk rate analysis suggests that socioeconomic status and access to social networks significantly influence the age of first fatherhood, with differences between urban and rural areas. Survival curves show that rural men are more likely to become fathers earlier in their lives, while urban men, especially those with higher education, tend to delay fatherhood. These findings highlight the need for public policies that consider the sociocultural and economic differences between urban and rural areas. Sexual education and family planning programs should be adapted to local realities, and awareness campaigns can use social media to promote responsible and informed parenthood in Brazil.

Keywords: Fatherhood; Family Dynamics; Family Planning; Urban and Rural Differences; Survival Analysis.

RESUMO

Este estudo examina como fatores sociodemográficos influenciam a decisão de se tornar pai pela primeira vez entre homens urbanos e rurais no Brasil. Utilizando dados da Pesquisa Nacional de Saúde de 2019 e aplicando modelos de análise de sobrevivência de Kaplan-Meier e de Cox, o objetivo é identificar e comparar os determinantes que afetam essa decisão em diferentes contextos geográficos. A metodologia incluiu análise detalhada das variáveis sociodemográficas, econômicas e de saúde, além do uso de redes sociais. Os resultados apontam que homens em áreas rurais tendem a se tornar pais mais cedo, influenciados por menores níveis de educação, enquanto em áreas urbanas, a educação superior tende a postergar a paternidade. Fatores como raça e região geográfica também são significativos: homens negros e residentes no Norte e Nordeste apresentam maior probabilidade de paternidade precoce. A análise das taxas de risco sugere que o status socioeconômico e o acesso à redes sociais influenciam significativamente a idade da primeira paternidade, com diferenças entre zonas urbanas e rurais. As curvas de sobrevivência mostram que homens rurais têm uma probabilidade maior de se tornar pais mais cedo em suas vidas, enquanto homens urbanos, especialmente os mais educados, tendem a postergar a paternidade. Os resultados indicam a necessidade de políticas públicas que considerem as diferenças socioculturais e econômicas entre áreas urbanas e rurais. Programas de educação sexual e planejamento familiar devem ser adaptados às realidades locais, e campanhas de conscientização podem utilizar redes sociais para promover uma paternidade responsável e informada no Brasil.

Palavras-chave: Paternidade; Dinâmicas Familiares; Planejamento Familiar; Diferenças Urbanas e Rurais; Análise de Sobrevivência.

RESUMEN

Este estudio examina cómo los factores sociodemográficos influyen en la decisión de ser padre por primera vez entre hombres urbanos y rurales en Brasil. Utilizando datos de la Encuesta Nacional de Salud de 2019 y aplicando modelos de análisis de supervivencia de Kaplan-Meier y de Cox, el objetivo es identificar y comparar los determinantes que afectan esta decisión en diferentes contextos geográficos. La metodología incluyó un análisis detallado de variables sociodemográficas, económicas y de salud, además del uso de redes sociales. Los resultados indican que los hombres en áreas rurales tienden a convertirse en padres más temprano, influenciados por niveles más bajos de educación, mientras que en áreas urbanas, la educación superior tiende a retrasar la paternidad. Factores como la raza y la región geográfica también son significativos: los hombres negros y los que residen en el Norte y Nordeste muestran una mayor probabilidad de paternidad temprana. El análisis de las tasas de riesgo sugiere que el estatus socioeconómico y el acceso a redes sociales influyen significativamente en la edad de la primera paternidad, con diferencias entre zonas urbanas y rurales. Las curvas de supervivencia muestran que los hombres rurales tienen una mayor probabilidad de convertirse en padres más temprano en sus vidas, mientras que los hombres urbanos, especialmente los más educados, tienden a retrasar la paternidad. Estos hallazgos destacan la necesidad de políticas públicas que consideren las diferencias socioculturales y económicas entre áreas urbanas y rurales. Los programas de educación sexual y planificación familiar deben adaptarse a las realidades locales, y las campañas de concienciación pueden utilizar redes sociales para promover una paternidad responsable e informada en Brasil.

Palabras clave: Paternidad; Dinámicas Familiares; Planificación Familiar; Diferencias Urbanas y Rurales; Análisis de Supervivencia.

1 INTRODUCTION

The results of the 2022 Brazilian Demographic Census revealed that, despite maintaining a growth trajectory, the Brazilian population continues to grow at a reduced rate. This dynamic reflects the historical process of transitioning from the balance between high and unstable mortality and birth rates in "traditional" societies to a supposedly modern pattern of lower and more stable levels of both components (Coale 1989; Lee 2003).

As a result of this transition, there is a significant increase in the age structure of the Brazilian population, mainly due to a proportional decrease in the 0 to 14 age group, indicating a narrowing at the base of the age pyramid. Consequently, although it is still primarily adult, the Brazilian population is experiencing an increased aging process. This phenomenon directly impacts the formulation of public policies, with special attention to social security, elderly health, and care policies. This phenomenon is known as the demographic transition process (Travassos; Coelho; Arends-Kuenning 2020).

This process is experienced differently among countries and regions, particularly concerning the birth rate dynamics. In Brazil, the birth rate declined from 20,86 to 12,62 births per thousand inhabitants from 2000 to 2022. In 2022, a significant regional variation was observed: while the North region had a rate of 16,66 births per thousand inhabitants, the Southeast recorded 11,55 (IBGE 2023).

The context of this trend is characterized by a reversal in nuptiality, resulting in the reduction in the proportion of marriages and remarriage rates after separation. Additionally, there is a reversal in the fertility period attributed to access to modern and effective contraceptive methods, a higher incidence of non-marital fertility, and an increase in the average age for fatherhood. The social context also influences this trend, emphasizing post-materialist needs such as autonomy and self-realization, increased female autonomy, and the diversity of family arrangements (Lesthaeghe 2014).

This analysis leads to sentimental and financial investment in the child, who is seen as an element of personal fulfillment. This aspect contrasts with the prevailing conception in typically rural societies, where children were seen as a productive factor, with the premise that a larger number of children implied greater availability of labor. In this sense, Lesthaeghe and Surkyn (1988) argue that cultural dynamics and economic theory are fundamental to understanding changes in decisions to have children. From a sociological perspective, theories of needs, values, and ideational goals, as well as additional theories related to cultural mobility, secularization, and individualization, stand out.

The literature on birth rates has predominantly focused on women, as only they can accurately confirm the number of children they have had, given their biological obligation of childbirth. However, this has created a gap in understanding the factors that influence men in this process. Recently, however, there has been a growing interest in the sociodemographic factors that affect the time until the birth of the first child from the paternal perspective. The birth of the first child is a significant milestone in an individual's life, marking a fundamental transition in social identity and responsibilities (Bakermans-Kranenburg et al. 2019).

The influence of sociocultural factors, such as social expectations regarding parents and opportunities for paternal care, is crucial to comprehend the dynamics of modern fatherhood (Bakermans-Kranenburg et al.).2019). In women's behavior, aspects such as age at marriage, marital satisfaction, social support, economic status, and quality of life are significant factors in men's decision to adopt children. These factors not only shape the decision to have children but also influence the timing of this decision (Kariman et al. 2016; Clementino 2021).

Increasing male age can impact sperm fertility and affect pregnancy outcomes (Humm; Sakkas 2013). Additionally, the family's socioeconomic status has been associated with early first birth and early marriage among men, suggesting a complex interrelationship between economy, culture, and reproductive decisions (Xu et al. 2018).

The prevalence of advanced paternal age has been associated with reduced fertility and increased complications related to pregnancy for both the father and mother (Sartorius; Nieschlag 2010. Furthermore, older men who become fathers for the first time may face higher health risks and adopt riskier health behaviors, such as alcohol consumption and smoking (Nilsen et al., 2013).

These findings underscore the importance of considering paternal age as a crucial factor in the study of fatherhood and its implications for family health.

In the Brazilian context, sociodemographic and economic dynamics present unique characteristics, especially when considering the division between urban and rural areas. National empirical studies have shown that factors such as education, income, access to health services, and health-related habits, such as having health insurance, alcohol consumption, smoking, and chronic diseases (cancer, heart disease, kidney disease, depression, cholesterol, diabetes, hypertension) play a significant role in men's reproductive decisions (Muniz 2009; Tejada et al 2017). Furthermore, access to and use of social networks can influence perceptions and decisions about fatherhood, reflecting a modern aspect of social interaction and information dissemination.

To deepen the understanding of the interactions between sociodemographic, health, and social network access factors that influence men's decision to start a family, this study applies survival analysis models to data obtained from the 2019 National Health Survey (PNS). The central focus of this article is to conduct a comparative analysis of sociodemographic, economic, health, and social network access determinants, emphasizing the differences observed between urban and rural areas in Brazil. The objective is to identify and compare the determinants that affect this decision in different geographic contexts, thus providing a more in-depth and contextualized view of the dynamics of first fatherhood among urban and rural families.

2 METHODOLOGICAL PROCEDURES

This study analyzes how sociodemographic factors, health, and social media usage influence paternal decisions to start a family in Brazil, using survival analysis models to compare differences between urban and rural areas.

The dataset utilized in this work comes from the 2019 National Health Survey (PNS), a collaboration between the Oswaldo Cruz Foundation (FIOCRUZ) and the Brazilian Institute of Geography and Statistics (IBGE). The PNS was chosen not only for its national-level health data but also for its information on lifestyle, housing, chronic diseases, and violence in the Brazilian population. Additionally, the survey included anthropometric measurements of a specific subsample. The PNS structure consists of three questionnaires. Two are answered by a resident household member. A third individual questionnaire is filled out by a resident aged 15 or older, selected among the adults in the household. This questionnaire provides data on morbidity and lifestyle of the residents in that housing unit (Stopa et al., 2020). The total sample of the 2019 PNS comprises 293,725 individuals, of whom 134,442 are men.

In obtaining the estimates, it is crucial to consider that the PNS is a survey with a complex sampling design. Therefore, in this study, sampling weights are applied and weighted so that the estimates obtained can be extrapolated to the population, which includes 53,439,556 men, of whom 45,491,415 live in urban areas and 7,948,141 in rural areas of the country.

The analysis focuses on the data obtained from the "Fatherhood and Partner's Prenatal Care" module of the 2019 PNS, with an emphasis on the age at which these individuals became fathers for the first time. This module provides detailed information on fatherhood, including data on men who became fathers for the first time. Within the analyzed sample, a total of 30,579 men reported the age at which they became fathers for the first time. To ensure accuracy and minimize potential biases arising from high data variability, an inclusion criterion was established, limiting the reproductive age range of men to 15 to 49 years (Harris et al., 2011; Martinez, Daniels, & Chandra, 2012).

The upper age limit for the monitoring period is set at 70 years. Older men are subject to a significant decline in fertility, especially from 35-39 years onwards, due to reduced fertility and sperm quality, and this trend continues with advancing age. Additionally, advanced paternal age is associated with lower fertilization and pregnancy rates in egg donation cycles (Matorras et al., 2010; Cito et al., 2019). Furthermore, this age limit includes approximately 94.5% of the total sample of men, providing comprehensive coverage of the reproductive-age male population.

The variables related to monitoring time, event status, and other explanatory covariates are defined as shown in Chart 01.

Chart 01 – Variable descriptions

Type	**Variable**	**Description**
monitoring time	age when the man first became a father	Age of the man at the time of the birth of the first child, or age at the end of the monitoring period if the man did not become a father during the study period
event variable	status	Indicates whether the event of interest (becoming a father) occurred during the monitoring period. Takes the value 1 if the man became a father and 0 otherwise (censorship)
stratification variable	age	Age of the man in complete years. Groups individuals into different age ranges to adjust the Cox proportional hazards model, allowing the baseline hazard rate to vary between these age groups.
covariates	education controls	Takes the value 1 if the individual is within the specific education range (illiterate, literate, primary education, secondary education, and higher education) and 0 otherwise.
	race controls	Takes the value 1 if the individual is within the specific race (white, black, yellow, brown, and indigenous) and 0 otherwise.

	macro-region controls	Takes the value 1 if the individual resides in a specific macro-region (North, Northeast, South, Southeast, and Central-West) and 0 otherwise.
	rural	Takes the value 1 if the individual resides in the rural area and 0 otherwise.
	married	Takes the value 1 if the individual is married and 0 otherwise.
	head of household	Takes the value 1 if the individual is the head of the household and 0 otherwise.
	monthly salary	Average monthly salary of individuals in Reais.
	health insurance	Takes the value 1 if the individual has a private health plan and 0 otherwise.
	access to social networks	Takes the value 1 if the individual accesses social networks at least once a day and 0 otherwise.
	alcohol	Takes the value 1 if the individual consumes alcoholic beverages at least once a month and 0 otherwise.
	smoker	Takes the value 1 if the individual is a smoker and 0 otherwise.
	cancer disseases	Takes the value 1 if the individual has been diagnosed with any type of cancer and 0 otherwise.
	heart disseases	Takes the value 1 if the individual has been diagnosed with heart disease and 0 otherwise.
	renal disseases	Assume valor 1 se o indivíduo recebeu diagnóstico de doença renal e 0, caso contrário.
	depression	Takes the value 1 if the individual has been diagnosed with depression and 0 otherwise.
	high cholesterol	Takes the value 1 if the individual has been diagnosed with depression and 0 otherwise.
	diabetes	Takes the value 1 if the individual has been diagnosed with diabetes and 0 otherwise.
	hypertension	Takes the value 1 if the individual has been diagnosed with hypertension and 0 otherwise.

Source: Developed by the author based on the 2019 PNS microdata (2024).

For covariates related to education, race, and region of residence controls, the base variables are, respectively, those related to illiterate individuals, self-declared whites, and those residing in the Southeast region. The inclusion of disease-related variables in the research is justified by the need to understand how health conditions impact the decision to fatherhood and the time until the birth of the first child. Formal diagnoses of chronic diseases can significantly influence reproductive health and men's quality of life, thus affecting their family and reproductive decisions (De Jonge & Barratt, 2019). Evidence also indicates that social media can influence reproductive decisions and men's reproductive health, justifying the inclusion of this covariate (Bernardi & Klärner, 2014; Langendorf, Padoin, & De Souza, 2020).

The class of regression models for survival data was selected based on the seminal works of Kaplan and Meier (1958) and Cox (1972). As highlighted by Fávero and Belfiore (2017), these models aim to analyze the probability of an event occurring within a monitoring period as a function of one or more predictor variables. In other words, the analysis will focus on the behavior of the survival function and the hazard rate of fatherhood occurrence in each monitoring period.

Survival analysis begins with the application of the Kaplan-Meier procedure, which aims to study the behavior of the survival function curve for the event in question, considering the monitoring times of the sample observations, including the presence of censored data. Thus, the values present in the survival function represent the probabilities of surviving the event for monitoring times greater than *t*, and are calculated as follows:

$$\hat{S}(t)=\prod_{j=t_0}^{t}\left(\frac{n_j-e_j}{n_j}\right) \qquad (1)$$

where $\hat{h}_0(t)$ represents the number of observations that did not present the event or censorship until the beginning of monitoring time *t* and *t* e e_t represents the number of events occurring for these observations with monitoring time exactly equal to *t.* Additionally, c_t can be defined as the number of censures occurring for these observations with monitoring time also exactly equal to *t*. Finally, t_0 corresponds to the shortest monitoring time among all monitoring times in the sample (Fávero & Belfiore, 2017). Thus, we have:

$$n_{t+1}=n_t-e_j-c_j \qquad (2)$$

Therefore, the number of censures occurring at a given monitoring time *t* does not interfere with the calculation of the survival probability for monitoring time greater than *t*. However, if censures occur at *t*, this fact will influence the calculation of survival probabilities for the event for monitoring times greater than *t + 1.*

Based on the calculations of survival probabilities for the event for different monitoring times, the survival function curve for the event, also known as the Kaplan-Meier survival probability curve, can be constructed. The Kaplan-Meier survival probability curves typically have a descending step shape, as the survival probabilities for longer monitoring times tend to be lower. Through this curve, the curve of occurrence probabilities of the event for different monitoring times can be elaborated, also known as the Kaplan-Meier failure probability curve, whose values are calculated based on the following expression:

$$n_{t+1} = n_t - e_j - c_j \qquad (2)$$

Kaplan-Meier failure probability curves typically also display a stepwise shape, but now ascending, as the probabilities of event occurrence for longer monitoring times tend to be higher. In addition to the survival function and event occurrence function, it is important to define the event hazard rate function, known as the failure rate function and represented by . Thus, the hazard rate (failure rate) for a monitoring time t can be defined as follows:

$$\hat{F}(t) = 1 - \hat{S}(t) \qquad (3)$$

The Kaplan-Meier failure probability curves typically also have a stepwise form, but now ascending, as the probabilities of event occurrence for longer monitoring times tend to be higher. In addition to the event survival function and the event occurrence function $\hat{S}(t)$, it is important to define the hazard rate function of event occurrence, known as the failure rate function and represented by $\hat{h}(t)$). Thus, the hazard rate of event occurrence (failure rate) for a monitoring time *t* can be defined as follows:

$$\hat{h}(t) = \frac{probability\ of\ event\ occurrence(\ failure)\ between\ times\ t - \Delta t\ and\ t}{(\Delta t)(\ probability\ of\ event\ occurrence(\ failure)\ after\ time\ t - \Delta t\ )} \qquad (4)$$

Therefore, using expression (3), we have:

$$\hat{h}(t) = \frac{\hat{S}(t - \Delta t) - \hat{S}(t)}{(\Delta t)\hat{S}(t - \Delta t)} \qquad (5)$$

More than merely defining the role of the hazard rate (failure rate) of the event's occurrence, it is essential to study how this can be influenced by the behavior of explanatory variables by estimating the Cox proportional hazards semiparametric model. This model is a natural extension of the Kaplan-Meier procedure but with regression characteristics. According to Fávero and Belfiore (2017), the expression of the failure rate as a function of predictor variables is defined as follows:

$$\hat{h}(t) = \hat{h}_{0i}(t)e^{(\beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki})} \qquad (6)$$

where $\hat{h}_0(t)$ represents the baseline hazard at time t, and t corresponds to the hazard of the event occurring at time t for a given observation i, when all its explanatory variables have values equal to zero. Additionally, β_j ($j = 1, 2, ..., k$) are the estimated parameters of each explanatory variable, X_j are the explanatory variables (metric or dummy), and the subscript *í* represents each observation in the sample (*i=1,2,...,ni = 1, 2, ..., ni=1,2*,..., n, where n is the sample size). Expression (6), which estimates the hazard of the event occurring for a given observation *í* monitored over a period of time t based on the behavior of its explanatory variables X, can also be written as follows:

$$ln\left[\hat{h}(t)\right] = ln\left[\hat{h}_{0i}(t)\right] + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} \qquad (7)$$

where each parameter β_j can be interpreted as the estimated increment in the logarithm of the hazard rate when the corresponding variable X increases by one unit, while keeping other conditions constant. Thus, each βj represents the increment in the hazard rate of the event occurrence relative to the baseline hazard rate when the corresponding variable X increases by one unit, with other conditions held constant.

Based on expression (6) and considering the relationship between the hazard function for the event occurrence and the survival function for the event, as given by expression (5), we can write:

$$\hat{S}(t) = \hat{S}_{0i}(t)e^{(\beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki})} \qquad (8)$$

where $\hat{S}_0(t)$ represents the baseline survival function for a monitoring time *t*, and *t* corresponds to the probability of surviving the event at *t*, for a given observation *i* when all its explanatory variables are equal to zero.

The Cox proportional hazards model is named as such because it assumes the principle of proportionality, which means it operates under the assumption that no explanatory variable X_j is dependent on the monitoring time. Additionally, Cox regression is considered semiparametric because, while it estimates the baseline survival function $\hat{S}_0(t)$ and the baseline hazard function $\hat{h}_0(t)$ non-parametrically, given that these functions have unknown distributions, it estimates the parameters β_j parametrically using partial maximum likelihood.

In survival analysis, especially when dealing with complex microdata, it is common to encounter issues related to the heterogeneity of variables. A central issue is the violation of the proportional hazard's assumption, which is fundamental to the Cox model. This assumption implies that the hazard ratio between two individuals is constant over time, which is not always feasible in complex datasets.

To address this limitation and improve the model's accuracy, a model stratified by age is used. Stratification treats each unique value in the age-related variable as a separate stratum, so that each stratum will have its own baseline hazard function in the Cox analysis. This means that the model does not assume a uniform baseline hazard function across all ages, and thus each coefficient will represent the average effect of the variable across all age categories. Stratified analysis involves dividing the survival data into mmm strata according to an indication of violation of the assumption (Samuelsen, Anestad, & Skrondal, 2007). The stratified model is expressed as:

$$S_{ij}(t) = \hat{S}_{0j}(t)e^{(\beta X'_{ij})} \quad (9)$$

for *j* = *1, ..., m* e *i* = *1, ..., n_j* where n_j is the number of observations in the *j*-th stratum. The baseline hazard functions λ_{01}, ..., λ_{0m}, are arbitrary and completely unrelated. Stratification does not complicate the estimation of the parameter vector *β*. A partial likelihood function is constructed for each stratum, and the estimation of *β* is based on the sum of the logarithms of the partial likelihood functions, as follows:

$$\ell(\beta)=\left[\ell_1(\beta)+\ldots+\ell_m(\beta)\right] \qquad (10)$$

with $\ell_j(\beta)=log\left[L_j(\beta)\right]$ obtained using only the data from individuals in the *j*-th stratum. The derivatives are found by summing the derivatives obtained for each stratum, and then $\ell(\beta)$ is maximized with respect to β.

3 PRESENTATION AND DISCUSSION OF RESULTS

This study aims to examine the impact of sociodemographic factors, health, and access to social networks on men's decision to become fathers, considering differences between urban and rural areas. To this end, two distinct models are estimated: one for men residing in urban areas and another for those in rural areas. This approach allows for a detailed comparative analysis, highlighting the specific characteristics that differentiate the experiences of fatherhood in these two contexts. Table 01 provides the detailed statistics for both the sample and the estimated population.

Table 01 – Descriptive statistics of the variables

Variables	Sample				Estimated Population	
	average	standard deviation	Minimum	Maximum	averagea	standard error
age at which the man became a father for the first time	25,47	5,74	15	49	25,75	0,0606
age	31,65	19,08	0	70	39,85	0,1299
status	0,2115	0,4084	0	1	0,6769	0,0051
Iliterate	0,1012	0,2743	0	1	0,0300	0,0014
literate	0,3897	0,4797	0	1	0,2574	0,0045
elementary education	0,1535	0,3546	0	1	0,1689	0,0041
high school education	0,2589	0,4331	0	1	0,3790	0,0055
higher education	0,0967	0,2871	0	1	0,1647	0,0046
white race	0,3428	0,4746	0	1	0,4253	0,0055
black race	0,1057	0,3075	0	1	0,1189	0,0033
asian race	0,0054	0,0735	0	1	0,0087	0,0010
mixed race	0,5384	0,4985	0	1	0,4405	0,0052
indigenous race	0,0076	0,0869	0	1	0,0065	0,0011
north region	0,2293	0,4204	0	1	0,0822	0,0019
northeast region	0,3528	0,4778	0	1	0,2434	0,0038

south region	0,1110	0,3142	0	1	0,1526	0,0031
southeast region	0,1967	0,3975	0	1	0,4389	0,0060
central-west region	0,1101	0,3130	0	1	0,0829	0,0022
rural	0,2565	0,4367	0	1	0,1488	0,0038
married	0,2869	0,4523	0	1	0,4780	0,0055
head of household	0,3332	0,4714	0	1	0,6324	0,0056
monthly salary	2205,86	3451,25	6	150000	2531,27	60,8935
health insurance	0,1969	0,3976	0	1	0,2831	0,0056
access to social networks	0,2077	0,4056	0	1	0,8007	0,0039
alcohol	0,1613	0,3679	0	1	0,5892	0,0058
smoker	0,0507	0,2194	0	1	0,1582	0,0039
cancer disseases	0,0044	0,0662	0	1	0,0108	0,0010
heart disseases	0,0115	0,1064	0	1	0,0287	0,0017
renal disseases	0,0036	0,0601	0	1	0,0085	0,0010
depression	0,0138	0,1166	0	1	0,0397	0,0022
high cholesterol	0,0314	0,1744	0	1	0,0960	0,0031
diabetes	0,0173	0,1303	0	1	0,0422	0,0020
hypertension	0,0574	0,2325	0	1	0,1573	0,0039

Source: Developed by the author based on the 2019 PNS microdata (2024).

From the descriptive statistics presented in Table 01, it is observed that the average age at which men become fathers is approximately 25 years, both in the sample and the estimated population, indicating a common pattern of fatherhood in Brazil.

The discrepancies observed between the sample and the estimated population in variables such as education, race, region of residence, and access to social networks can be attributed to differences in the demographic and socioeconomic composition of the sample relative to the general population. Furthermore, the increased prevalence of access to social networks in the estimated population may reflect the increasing digitalization and connectivity in Brazilian society, a factor that can influence perceptions and decisions regarding fatherhood. Additionally, differences in health-related variables, such as alcohol consumption and the prevalence of chronic diseases, suggest variations in lifestyle and health challenges faced by different segments of the male population (Rehman, Ahmad, & Alshahrani, 2018).

Table 02 shows the frequency distribution of the status variable related to the event "first fatherhood".

Table 02 – Frequency distribution of the status variable

Status	Absolute Frequency	Percentage Frequency	Cumulative Frequency
Censored	103.863	77,34	77,34
Event (first fatherhood)	30.438	22,66	100,00
Total	134.301	100,00	

Source: Developed by the author based on the 2019 PNS microdata (2024).

The data in Table 02, 103,863 individuals, or 77.34% of the total sample, fall into the censored category, indicating that the majority of individuals in the sample did not become fathers during the observation period. Additionally, 30,438 individuals, corresponding to 22.66% of the sample, fall into the event category, suggesting that they experienced fatherhood for the first time.

Table 03 provides the results of the survival function estimates for the first fatherhood relative to the sample of men from urban areas, obtained through the Kaplan-Meier procedure.

Table 03 – Survival probabilities for the event "first fatherhood" for each monitoring time of men in urban areas of Brazil

Time (age)	Initial Total	Failures	Survival Function	Standard Error	Confidence Interval (95%)	
					Lower limit	Higher limit
15	21535	94	0,9956	0,0004	0,9947	0,9964
16	21441	253	0,9839	0,0009	0,9821	0,9855
17	21188	503	0,9605	0,0013	0,9578	0,9630
18	20685	907	0,9184	0,0019	0,9147	0,9220
19	19778	1057	0,8693	0,0023	0,8648	0,8738
20	18721	1339	0,8072	0,0027	0,8018	0,8124
21	17382	1342	0,7448	0,0030	0,7390	0,7506
22	16040	1578	0,6716	0,0032	0,6652	0,6778
23	14462	1568	0,5987	0,0033	0,5922	0,6053
24	12894	1386	0,5344	0,0034	0,5277	0,5410
25	11508	1738	0,4537	0,0034	0,4470	0,4603
26	9770	1407	0,3883	0,0033	0,3818	0,3949
27	8363	1184	0,3334	0,0032	0,3271	0,3397
28	7179	1172	0,2789	0,0031	0,2730	0,2849
29	6007	841	0,2399	0,0029	0,2342	0,2456
30	5166	1071	0,1902	0,0027	0,1849	0,1954
31	4095	647	0,1601	0,0025	0,1552	0,1650
32	3448	658	0,1296	0,0023	0,1251	0,1341
33	2790	535	0,1047	0,0021	0,1007	0,1088
34	2255	431	0,0847	0,0019	0,0810	0,0885

35	1824	402	0,0660	0,0017	0,0628	0,0694
36	1422	291	0,0525	0,0015	0,0496	0,0556
37	1131	230	0,0418	0,0014	0,0392	0,0446
38	901	220	0,0316	0,0012	0,0293	0,0340
39	681	134	0,0254	0,0011	0,0234	0,0276
40	547	165	0,0177	0,0009	0,0160	0,0196
41	382	90	0,0136	0,0008	0,0121	0,0152
42	292	76	0,0100	0,0007	0,0088	0,0114
43	216	61	0,0072	0,0006	0,0061	0,0084
44	155	38	0,0054	0,0005	0,0045	0,0065
45	117	46	0,0033	0,0004	0,0026	0,0041
46	71	19	0,0024	0,0003	0,0018	0,0031
47	52	19	0,0015	0,0003	0,0011	0,0021
48	33	22	0,0005	0,0002	0,0003	0,0009
49	11	11	0,0000	- -	- -	- -

Source: Developed by the author based on the estimate results (2024).

The survival function attributed to the event of "becoming a father for the first time" for urban men shown in Table 03 indicates a gradual decrease with increasing age. At 15 years old, the probability of a man not having become a father is extremely high, around 99.56%. However, this probability decreases sharply over the years. For example, by age 30, only about 19% of the men in the sample had not yet experienced fatherhood.

This downward trend is consistent and continuous over the monitoring period, with significant drops at certain age groups, such as 18, 20, 25, and 30 years. These points can be considered crucial in the transition to first fatherhood for urban men. The results suggest that in urban areas, the decision or opportunity to become a father is influenced by age, with a significantly lower probability of fatherhood as men age, especially after 20 years (Tejada et al., 2017).

In addition, Table 04, presents the results of the survival function estimates for the first fatherhood relative to the sample of men from rural areas, obtained through the Kaplan-Meier process.

Table 04 – Survival probabilities for the event "first fatherhood" for each monitoring time of men in rural areas of Brazil

Time (age)	Initial Total	Failures	Survival Function	Standard Error	Confidence Interval (95%)	
					Lower limit	Higher limit
15	8903	40	0,9955	0,0007	0,9939	0,9967
16	8863	107	0,9835	0,0014	0,9806	0,9859
17	8756	222	0,9586	0,0021	0,9542	0,9625
18	8534	382	0,9156	0,0029	0,9097	0,9212

19	8152	467	0,8632	0,0036	0,8559	0,8702
20	7685	695	0,7851	0,0044	0,7765	0,7935
21	6990	626	0,7148	0,0048	0,7053	0,7241
22	6364	815	0,6233	0,0051	0,6131	0,6332
23	5549	797	0,5338	0,0053	0,5233	0,5441
24	4752	663	0,4593	0,0053	0,4489	0,4696
25	4089	760	0,3739	0,0051	0,3639	0,3840
26	3329	609	0,3055	0,0049	0,2960	0,3151
27	2720	472	0,2525	0,0046	0,2435	0,2616
28	2248	422	0,2051	0,0043	0,1968	0,2135
29	1826	300	0,1714	0,0040	0,1637	0,1793
30	1526	338	0,1334	0,0036	0,1265	0,1406
31	1188	190	0,1121	0,0033	0,1056	0,1188
32	998	186	0,0912	0,0031	0,0853	0,0973
33	812	136	0,0759	0,0028	0,0705	0,0816
34	676	124	0,0620	0,0026	0,0571	0,0671
35	552	103	0,0504	0,0023	0,0460	0,0551
36	449	88	0,0405	0,0021	0,0366	0,0448
37	361	65	0,0332	0,0019	0,0297	0,0371
38	296	78	0,0245	0,0016	0,0214	0,0279
39	218	37	0,0203	0,0015	0,0176	0,0234
40	181	47	0,0151	0,0013	0,0127	0,0177
41	134	28	0,0119	0,0011	0,0098	0,0143
42	106	31	0,0084	0,0010	0,0067	0,0105
43	75	18	0,0064	0,0008	0,0049	0,0082
44	57	10	0,0053	0,0008	0,0039	0,0070
45	47	18	0,0033	0,0006	0,0022	0,0046
46	29	10	0,0021	0,0005	0,0013	0,0033
47	19	9	0,0011	0,0004	0,0006	0,0020
48	10	6	0,0004	0,0002	0,0002	0,0011
49	4	4	0,0000	- -	- -	- -

Source: Developed by the author based on the estimation results (2024).

The results from Table 04 also indicate a decrease in the likelihood of becoming a father for the first time with advancing age among country men. At 15 years old, the probability of a country man not yet having a father is very high, approximately 99.55%. However, this probability gradually decreases over the years. At 20 years old, the probability decreases to approximately 78.51%, and by age 30, it further decreases to approximately 13.34%. This declining trend is continuous across the analyzed ages, with significant drops in the probability of not having become a father, especially between the ages of 18 and 22, suggesting that this is the critical period for the transition to fatherhood in rural areas.

In a comparative analysis using the Kaplan-Meier method, it is evident that, in both urban and rural areas, the probability of becoming a father for the first time decreases by age. However, the rate of decrease and the points of inflection vary. In urban areas, the decrease in the survival function appears to be more gradual, while in rural areas, there is a more noticeable decline at specific ages. The results suggest that the transition to fatherhood in rural areas appears to occur at a younger age than in urban areas.

The observed disparities can be attributed to distinct socioeconomic and cultural factors prevalent in urban and rural regions. In rural areas, factors such as family traditions, limited access to education and healthcare, and an agricultural-based economy may influence the decision to become a father. In urban areas, factors such as greater access to education, diverse career opportunities, and cultural trends may lead to a postponement of fatherhood (Anderson & Schneider, 2014.).

Table 05 provides the estimates for the Cox proportional hazards model for the population, both for urban and country individuals.

Table 05 – hazard ratios for the decision to fatherhood between urban and country men in Brazil

Variables	Standard Model		Stratified Model	
	urban	country	urban	country
literate	1,1110 (0,0774)	0,8475** (0,0663)	1,1629** (0,0814)	0,8897* (0,0628)
elementary education	0,9495 (0,0710)	0,6936*** (0,0660)	1,1968** (0,0887)	0,8081** (0,0684)
high school education	0,7224*** (0,0520)	0,5856*** (0,0528)	0,8806* (0,0636)	0,6465*** (0,0538)
higher education	0,5352*** (0,0412)	0,4656*** (0,0550)	0,5894*** (0,0445)	0,4444*** (0,0516)
black race	1,1597*** (0,0537)	1,0218 (0,0710)	1,1860*** (0,0519)	1,0079 (0,0902)
asian race	0,9190 (0,1323)	0,8214 (0,1247)	0,8143 (0,1214)	0,7390** (0,1127)
mixed race	1,1718*** (0,0396)	1,0525 (0,0498)	1,1852*** (0,0354)	1,1022** (0,0468)
indigenous race	1,1588 (0,2927)	1,0330 (0,2054)	1,3006 (0,2810)	1,1123 (0,2208)
north region	1,3679*** (0,0542)	1,3798*** (0,0870)	1,3113*** (0,0517)	1,3856*** (0,0823)
northeast region	1,1876*** (0,0395)	1,1400** (0,0679)	1,1627*** (0,0385)	1,1088* (0,0595)
south region	1,0646* (0,0389)	1,0418 (0,0670)	1,0640* (0,0379)	1,0536 (0,0638)
central-west region	1,2144*** (0,0470)	1,1083 (0,0896)	1,2095*** (0,0458)	1,0777 (0,0770)
married	2,1249*** (0,0644)	1,9664*** (0,0959)	1,6060*** (0,0447)	1,6783*** (0,0721)
head of household	1,4978*** (0,0492)	1,9146*** (0,1207)	1,1117*** (0,0332)	1,3224*** (0,0679)
monthly salary	1,0000*** (0,0001)	1,0000*** (0,0001)	1,0000 (0,0001)	1,0000** (0,0001)
health insurance	0,9568 (0,0338)	1,1013 (0,724)	0,9241** (0,0291)	1,0923 (0,0693)

access to social networks	0,9087*** (0,0302)	0,9654 (0,0459)	1,0883** (0,0382)	1,0308 (0,0444)
alcohol	1,1572*** (0,0323)	1,0847* (0,0468)	1,1311*** (0,0294)	1,0340 (0,0393)
smoker	1,1023** (0,0432)	1,0629 (0,0620)	1,0989** (0,0430)	1,0669 (0,0535)
cancer disseases	1,2357** (0,1020)	1,1692 (0,1373)	1,0700 (0,0958)	1,2822** (0,1591)
heart disseases	1,0582 (0,0821)	1,0574 (0,1094)	1,0456 (0,0723)	1,0824 (0,1133)
renal disseases	1,0271 (0,1745)	1,2048 (0,3097)	1,1913 (0,1332)	1,0774 (0,2726)
depression	1,0906 (0,0715)	1,0244 (0,0868)	1,0771 (0,0691)	1,0133 (0,0975)
high cholesterol	1,0532 (0,0402)	1,1369** (0,0700)	0,9884 (0,0377)	1,0729 (0,0657)
diabetes	1,0882 (0,0598)	1,0225 (0,0990)	1,0481 (0,0583)	1,0834 (0,1001)
hypertension	1,1343*** (0,0366)	1,0823 (0,0557)	0,9577 (0,0313)	1,0735 (0,0544)

Source: Developed by the author based on the estimation results (2024).
Notes: Significance levels: (***) = 1%; (**) = 5%; (*) = 10%Standard errors are in parentheses.

The choice of an age-stratified model in survival analysis is justified due to the need to control for confounding variables, particularly age, which significantly influences the decision to become a father. This approach allows for a more precise analysis by examining the heterogeneity among the subgroups of urban and country men (Samuelsen, Anestad, and Skrondal, 2007). In Table 05, it can be observed that the standard deviations in the stratified models tend to be smaller, indicating more accurate estimates. Presenting estimates from the traditional model (without stratification) provides a robustness check and allows comparisons to confirm the consistency of the results.

In Table 05, there is a distinction in the impact of education on the decision to become a father between urban and country men. For urban men, higher education levels have a hazard ratio of 0.5894, indicating a lower probability of becoming fathers, reflecting a more anticipated or delayed decision. On the other hand, for country men, primary and secondary education levels, with hazard ratios of 0.8081 and 0.6465, respectively, suggest a lower tendency towards fatherhood compared to those less educated, possibly due to different opportunities and cultural traditions in rural areas (Anderson & Schneider, 2014).

In relation to the variables related to race, the results indicate differences in fatherhood among urban and country men. For urban men, black race (hazard ratio of 1.1860) and mixed race (hazard ratio of 1.1852) demonstrate a higher likelihood of fatherhood than the white race, suggesting cultural and socioeconomic influences on the decision to become a father. In contrast, for country men, the differences are less pronounced, with the black race having a hazard ratio of 1.0079 and the brown race a hazard ratio of 1.1022, indicating less variation in the probability of fatherhood among different races in this context. The Asian and indigenous races do not have a significant impact on the decision to become a father, both in urban and country men.

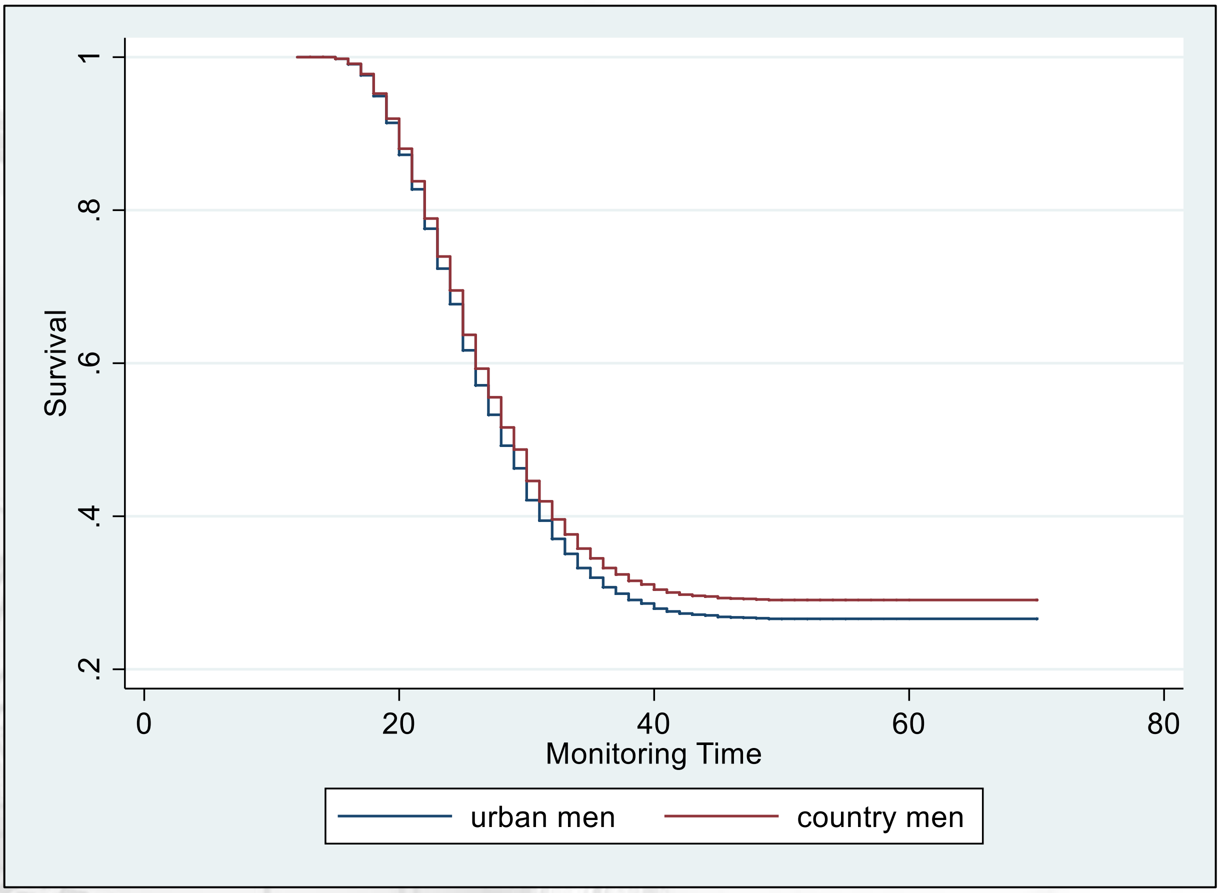
In urban areas, the North region (hazard ratio of 1.3113) and Northeast region (1.1627) have higher probability of fatherhood than the Southeast region. In rural areas, these differences are more evident: the North region has a hazard ratio of 1.3856, and the Northeast region, 1.1088, indicating a stronger tendency towards fatherhood than the Southeast. In urban men, the Center-West region has a hazard ratio of 1.2095, indicating a slightly higher probability of fatherhood than the Southeast, while the South has a hazard ratio of 1.0640, suggesting a less pronounced difference. The results suggest that, in both urban and rural areas, the Center-West and South regions have a lower tendency towards fatherhood than the Southeast, but the differences are more subtle than in the North and Northeast regions. This indicates that regional influences on the decision to become a father may be less noticeable in the Center-West and South.

From Table 05, it can be observed that urban married men possess a significantly higher probability of fatherhood, as do those who are members of households. However, the impact of salary and access to social networks is less significant. Moreover, in rural areas, being married and being the head of the household also increases the likelihood of fatherhood. However, salary and access to social networks do not demonstrate a statistically significant impact. The results suggest that in rural areas, economic and digital connectivity aspects have less influence on decisions regarding fatherhood, highlighting the significance of social and family factors (Rose, 2011).

In regard to morbidity and health-related behaviors, differences between urban and rural country can be observed. Among urban men, having health insurance (hazard ratio of 0.9241), alcohol consumption (1.1311), and smoking (1.0989) contribute significantly to fatherhood. In rural areas, having health insurance and smoking demonstrate non-significant effects, such as alcohol consumption. The lack of statistical significance for some of these variables in rural areas suggests that health issues and risk behaviors may contribute to the decision to become a father in this area, compared to urban areas.

Figure 01 provides the survival probability curves for first-time fatherhood for urban and country men.

Figure 01 – Survival probability curves for first-time fatherhood for urban and country men in Brazil

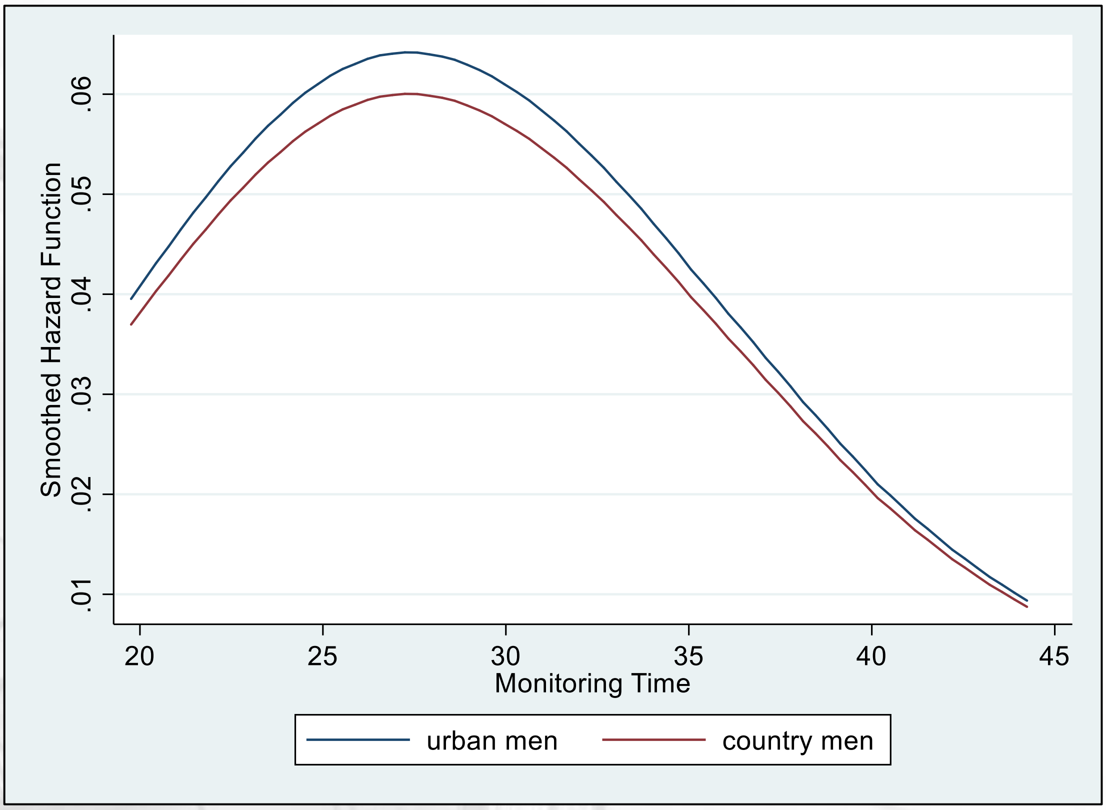


Source: Developed by the author based on the estimation results (2024).

In Figure 01, we observe a difference in survival trajectories by age between urban and country men. Men in urban areas tend to become fathers at a younger age, as indicated by the steeper decline in their survival. In contrast, the curve for country men shows more prolonged survival without fatherhood at younger ages, suggesting they become fathers later in life.

From the age of 40, the survival curves for urban and country men show a consistent difference. This indicates that while the probability of becoming a father decreases with age for both groups, the disparity in the number of fatherhoods between urban and rural areas remains stable after age 40. This suggests that the factors influencing the decision to become a father at younger ages in rural areas, such as cultural traditions or economic pressures, may have less impact from this age onwards, resulting in similar patterns of late fatherhood in both zones (Instituto Promundo, 2019).

Figure 02 – Curves of risk rates for the occurrence of first paternity for urban and country men in Brazil



Source: Developed by the author based on the estimation results (2024).

Estimating the risk rate curves for the first paternity occurrence in Figure 02, the behaviors of urban and country men are separated. Figure 02 shows that both curves begin from a different point around age 20, indicating that the propensity to become a father for the first time begins to increase at this age for both groups. However, the risk rate for urban men is slightly higher than that of country men, which may suggest a marginally higher inclination for early paternity in urban areas at this particular age range.

As the curves increase until approximately age 28, there is a constant increase in the likelihood of becoming a father, peaking at this age. This pattern suggests that the late youth years are a crucial period for transitioning to paternity in both instances. In urban areas, the curve for urban men reaches a higher *sk* rate (0.065) compared to rural country (0.060), indicating a slightly higher probability of paternity at this age in urban areas.

After the age of 28, the risk rates begin to decline for both groups, resulting in a decrease in the likelihood of becoming a father for the first time as men age. This decline is consistent with what would be expected, given that men generally begin families earlier in life (Instituto Promundo, 2019).

From the age of 30, the curves begin to converge, and the difference in risk rates between urban and country men decreases. This convergence suggests that, while there are differences in early paternity rates between urban and rural areas, these differences become less pronounced as men become older and 40 years old. By age 44, the risk rates are almost identical between the groups, indicating that the likelihood of becoming a father for the first time is approximately similar in both areas for men in this age range. In summary, the differences in the probability of becoming a father for the first time attenuate with age, resulting in more similar paternity patterns at older ages (Kaltsas et al., 2023).

Figures 01 and 02 show the existence of disparate behaviors between urban and country men regarding the possibility of becoming a father for the first time. The Log-rank test is used to determine the existence of statistically significant differences between the survival function curves (or risk of occurrence of the event) for the groups of urban and country men. Table 06 provides the results for the Log-rank test applied to the sample data.

Table 06 – Log-rank test results for equality of survival functions

Subsample	Observed Events	Expected Events
urban men	21535	22760,23
country men	8903	7677,77
Total	30438	30438,00
$\chi 2$ Statistic	265,08	
p-value	0,0000	

Source: Developed by the author based on the estimation results (2024).

The Log-rank test asserts that the two survival curves for the event are statistically equal. Therefore, the results presented in Table 06 indicate that the survival probabilities for first paternity are different for the groups of urban and country men, corroborating previous evidence that the probability of becoming a father for the first time over time varies significantly between urban and country men.

4 FINAL CONSIDERATIONS

By utilizing survival analysis models to the data from the 2019 National Health Survey (PNS), this study obtains significant results on family dynamics between urban and rural families in Brazil. The study explores sociodemographic, economic, health, and social network access determinants, revealing distinct trends in paternity decisions in urban and rural areas. The comparative analysis of survival functions and risk rates for first paternity revealed that the probability of becoming a father for the first time decreases with age, with differences between urban and rural areas.

Urban men become fathers later, while in rural areas, paternity occurs earlier. These variations can be attributed to socio-economic and cultural variations. Factors such as family traditions, access to education and health, and the agricultural economy in rural areas contribute to the early paternity. Moreover, in urban areas, education and career opportunities contribute to preventing paternity.

Public policies focused on sexual and reproductive education, access to reproductive health services, and awareness programs about responsible paternity could be implemented and directed at post-adolescent and young adult men. Initiatives that promote gender equality and economic prosperity in rural areas are also essential. Furthermore, social media campaigns can be used to disseminate information and break the stigmas associated with late paternity. These measures can assist in creating more planned and conscious families, utilizing the realities of both urban and rural areas.

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