Intergenerational Persistence of Education: Evidence across Three Generations for Brazil

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Abstract: The studies regarding educational mobility in Brazil focus on just two consecutive generations, parents and their children. However, economists and social scientists have long been interested in the persistence of outcomes across three generations or multigenerational mobility. Therefore, the purpose of this paper is to analyze the multigenerational persistence of education in Brazil. To our knowledge, this is the first study testing the multigenerational persistence of education in the country. Furthermore, we investigate whether the effect of grandparents' education on grandchildren's educational attainment differs by gender, and we distinguish between indirect and direct grandparental effects. The database to carry out this study is the National Household Sample Survey, especially the complement of socio-occupational mobility. The study is composed of data from 2,073 families, and there is schooling data for at least one individual in each of the three consecutive generations. Results show that grandparents' education matters for grandchildrens' education and that the intergenerational effects can persist beyond two generations only through matrilineal lineage for grandsons. We find that the grandmother's and grandfather's educational status directly influences their grandson's educational attainment, over and above the effect transmitted through the mother. It is noteworthy that we found some limitations in the construction of the sample, such as the fact that data from three generations can only be constructed when the younger generation co-residents with the parents.

Keywords: Intergenerational Persistence of Education. Multigenerational Mobility. Grandparents.

Resumo: Os estudos sobre mobilidade educacional no Brasil tem como enfoque apenas duas gerações consecutivas, pais e filhos. No entanto, economistas e cientistas sociais há muito se interessam pela persistência dos resultados ao longo de três gerações ou pela mobilidade multigeracional. Portanto, o objetivo deste artigo é analisar a persistência multigeracional da educação no Brasil. Até onde sabemos, este é o primeiro estudo que testa a persistência multigeracional da educação no país. Além disso, investigamos se o efeito da educação dos avós no desempenho educacional dos netos difere por gênero, e distinguimos entre os efeitos indiretos e diretos dos avós. A base de dados para a realização deste estudo é a Pesquisa Nacional por Amostra de Domicílios, especialmente o complemento da mobilidade sócio-ocupacional. Compõem o estudo, dados de 2.073 famílias, em há dados de escolaridade de pelo menos um indivíduo em cada uma das três gerações consecutivas. Os resultados mostram que a educação dos avós é importante para a educação dos netos e que os efeitos intergeracionais podem persistir por mais de duas gerações apenas através da linhagem matrilinear para os netos. Descobrimos que o status educacional da avó e do avô influencia diretamente o desempenho educacional de seu neto, além do efeito transmitido pela mãe. Ressalta-se que encontramos algumas limitações na construção da amostra, como por exemplo o fato de que os dados de três gerações só podem ser construídos quando a geração mais nova co-reside com os pais.

Palavras-chave: Persistência Intergeracional de Educação. Mobilidade Multigeracional. Avós.

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1 Introduction

"High mobility lessens the sting of being at the wrong end of inequality…" (Mare, 2011, p. 5). According to Mare (2011), the understanding of inequality needs to consider the role of intergenerational mobility in loosening or tightening the link between the socioeconomic positions of one generation and those of the next. When links do not exist or are less close, mobility rates are high, and inequalities are small. On the other hand, lower mobility rates amplify the costs and benefits of one's socioeconomic position, and this is all the more real if reinforced by multigenerational effects.

Thus, economists and social scientists have long been interested in the persistence of outcomes across three generations or multigenerational mobility. They want to know if grandparents' outcomes matter for grandchildren's outcomes. In the last decade, studies on multigenerational mobility have been carried out for several countries. More specifically about multigenerational educational mobility, there are studies for the United States (Kroeger &Thompson, 2016; Neidhöfer & Stockhausen, 2018; Daw; Gaddisb; Morsea, 2020), United Kingdom (Neidhöfer & Stockhausen, 2018), Germany (Neidhöfer & Stockhausen, 2018; Braun & Stuhler, 2016), Swedish (Lindahl et al., 2015), Chile (Celhay & Gallegos, 2015), Turkey (Aydemir & Yazici, 2019), African countries (Razzu & Wambile, 2020), Australia (Hancock et al., 2018), Taiwan (Chiang & Park, 2015); Europe and Israel (Deindl & Tieben, 2017), Finland (Lehti, Erola, & Tanskanen, 2018); México (Arenas, 2017).

For Brazil we have not identified any study on multigenerational mobility of education. The studies regarding educational mobility in Brazil focus on just two consecutive generations, parents, and their child (Mahlmeister et al., 2019; Ramalho & Netto Júnior, 2018; Longo & Vieira, 2017; Annegues & Figueiredo, 2016; Ribeiro et al., 2015; Gonçalves & Silveira Neto, 2013; Netto Júnior, Ramalho & Silva, 2013; Netto Júnior & Figueiredo, 2009; Ferreira & Veloso, 2003).

Therefore, the main purpose of this paper is to analyze the multigenerational persistence of education for Brazil. Furthermore, we investigate whether the effect of grandparents' education on grandchildren's educational attainment differs by gender, and we distinguish between indirect and direct grandparental effects. In the indirect one, they affect their children's success, which affects their children. In contrast, in the second one, they affect their grandchildren's status even when the middle generation's status attributes are held constant (Bol & Kalmijn, 2016).

To our knowledge, this is the first study testing the multigenerational persistence of education for Brazil. We found only one study on multigenerational income mobility in Brazil, written by Marchon (2014). We contribute to the current debate and extend the existing literature in four ways. First, we assemble a sample of approximately 1,126 men and 803 women born mostly between 1980 and 1989 with linked information on their parents' educational attainments and maternal or paternal grandparents, then use this data to estimate the level of educational persistence across two and three generations in Brazil.

The second contribution is that despite the mobility between two generations literature bringing forward relevant evidence of the short-term mobility, they may be producing intergenerational persistence estimates below an estimate based on three or more generations, as evidence in international literature. Thus, we can confirm or refute that educational inequality persists in the long-term, that is, in more than one generation of the same family in Brazil. Finally, we can verify whether the coefficients of intergenerational persistence of education found in this study are similar to those of other countries.

These contributions are important because high rates of intergenerational mobility indicate that there is inclusive growth, sustainable poverty reduction, and greater equity. On the other hand, if results show low mobility rates, reinforcements are needed to increase opportunities and access for individuals born at a disadvantage (World Bank Group, 2017). In this sense, "the analysis of long-run intergenerational persistence of social status is crucial for a social planner who strives to level the playing field" (Neidhöfer & Stockhausen, 2018, p.2).

The database to carry out this study is the National Household Sample Survey, especially the complement of socio-occupational mobility, answered by a resident of 16 years old or more selected

randomly at each household. The data set includes 2073 families where education data are available for at least one individual in each of three consecutive generations.

The paper proceeds as follows. Section 2 presents empirical evidence about multigenerational mobility in the world. Section 3 describes the utilized data and the mensuration of the intergenerational and multigenerational mobility. Section 4 presents the estimations' results, Section 5 discusses mechanisms that may help explain our findings, and Section 6 concludes the paper.

2 The current state of the literature

The extent to which grandparents, directly and indirectly, influence the outcomes of their grandchildren has been a primary focus of the emerging multigenerational literature (Hancock et al., 2018). Anderson et al. (2018) made a systematic review of articles that investigate the question: are educational outcomes subject to a "grandparent effect"? They identified and extracted findings of 69 analyses and fifty-eight percent of them report that grandparents' socioeconomic characteristics are associated with grandchildren's educational outcomes, independently of the characteristics of parents. Moreover, they observed that estimate multigenerational mobility differ in the methods of the analyze and to include several further substantively interesting questions, how potential mechanisms underlying a direct effect of grandparents, which contact-based and non-contact-based; inclusion of one or both parents; whether there is evidence for particular grandparents being especially important in the transmission of socioeconomic status; whether results are robust to different specifications within analyses, etc.

Among these studies identified in the systematic review's Anderson et al. (2018), it is the analysis the multigenerational persistence for the United States (U.S.), the United Kingdom (U.K.), and Germany, research of Neidhöfer & Stockhausen (2018). The U.K. showed the highest degree of intergenerational mobility, and Germany the lowest. In the regression analysis including both parents and grandparent's education, the grandparental coefficient is positive and significant for Germany and the U.K. It also revealed gender-specific pathways in the transmission of social status across two and three generations. In all three countries, the intergenerational persistence of maternal education on the education of the daughter is higher than the coefficient of paternal education on sons, while the coefficient of grandfathers on fathers is higher than the coefficient of grandmothers on mothers.

Razzu & Wambile (2020) provided estimates of three generation educational mobility for six African countries: Ethiopia, Gambia, Ghana, Liberia, Nigeria and Tanzania. They found higher levels of three generational mobility in Liberia, Ethiopia, Ghana and Gambia compared to Nigeria and Tanzania. Furthermore, they identified a positive and significant net effect of the grandparents' educational status on the educational outcome of their grandchildren, over and above that of their parents. The influence of grandparents is smaller, approximately one-fifth that of parents. They also found that the association between grandparents and children's educational outcomes is more pronounced for female than male children in all countries but Nigeria. Razzu & Wambile (2020) too analyzed that the extent of the relationship positively depends on whether grandparents live in the same household with their grandchildren. There is a stronger effect if grandparents live with their grandchildren than if they do not, pointing to the importance of more direct and continuous interactions between the generations.

Using data from Sweden, Lindahl et al. (2015) found that grandparents' educational outcomes directly affect the grandchildren's outcomes. Moreover, differently from Razzu & Wambile's (2020) findings, they evidenced that correlation between the first and third generations is almost the same for males and females in the third generation. Kroeger & Thompson (2016) estimated the intergenerational persistence of educational attainment across three generations of women in the US. They found that grandmother and granddaughter education have a statistically significant correlation after conditioning on mother's education.

The first study to examine long-run educational mobility for a Latin American country was written for Celhay & Gallegos (2015). The results evidenced that grandsons benefit from both grandparents within the patrilineal lineage, while the maternal grandfather has the strongest influence for the matrilineal lineage. Meanwhile, the association between grandmother and granddaughters is significant for both lineages, but its magnitude is markedly higher within the patrilineal lineage. That is, women born to low-educated

grandmothers and high-educated grandfathers have lower education than granddaughters born to higher educated grandmothers and lower educated grandfathers. Thus, having more educated same-sex ancestors matters more for women and suggests that gender-related social roles may be passed along generations within families.

Other studies in the field of educational results involving three generations also stand out in the literature. However, they do not have as the main objective to estimate the coefficient of intergenerational persistence, but rather, if the level of education and/or grandparents' income is related to grandchildren. Bol & Kalmijn (2016) investigated the grandparent effect in the Netherlands. They find that educational attainment, occupational status, and cultural resources only indirectly affect the grandchild's educational attainment. Once it includes information on the middle generation's resources, the grandparent effects disappear. Moreover, it did not evidenced a stronger effect when grandparents live close.

On the other hand, Zeng and Xie (2014) showed that in rural China, grandparents do exert a direct effect on their grandchildren. However, this effect is characterized by the interaction between grandparents' education and living arrangements. Deindl & Tieben (2017) affirm that different welfare state arrangements have an influence on the relevance of grandparental resources for children's educational outcomes. They observed that in Sweden, the Netherlands, Belgium, and Slovenia, neither the grandparents' education nor financial resources significantly contribute to children's educational outcomes. However, in Germany, Israel, and Denmark, both types of grandparental resources (educational and financial) have a significant estimated effect. In the Czech Republic and Luxembourg, only the grandparents' education seems relevant, whereas, in Italy, only financial resources are associated with children's educational attainment.

In the research of the Jæger (2012), using data from the Wisconsin Longitudinal Study, it was identified that the education of grandparents exerts a direct effect on their grandchildren's educational success. However, the effect is minimal and limited to children raised by the poorest parents. These different results are in line with what Mare (2011) argued, that the effect of grandparents on their grandchildren might vary between and within countries and depend on the historical and institutional context.

3 Method

3.1 Data

To achieve the purpose of this study, we use the data set of the 2014 National Household Sample Survey (PNAD), a nationwide population-based household survey that aims to obtain representative information on the Brazilian population concerning socio-demographic, educational, housing, work, and income characteristics. The 2014 edition included a Socio-Occupational Mobility Supplement, which has information on the educational attainment of all individuals living in the house and the parents of the supplement's respondent.

We included in the analysis families whose head of household (t-1) has a son or daughter of at least 25 years (t) of age living in the same residence. Furthermore, the head of household (t-1) needs to have answered the socio-occupational mobility supplement: which has information about the educational level of the household head's father and mother (t-2 generation). This information allows us to reconstruct the educational history of families over three consecutive generations.

From the data referring to the years of education of at least one individual of each generation, it is possible to calculate the coefficient of intergenerational persistence of education between generations and to identify the association of years of education between parents and children and grandparents and grandchildren. It is essential to highlight that we restrict the analysis of years of education to individuals of the generation t who were at least 25 years of age in 2014, excluding those born after 1989. The age restriction helps us to avoid the problem that some individuals in the generation t may have still been in school at the time of the most recent data collection. Thus, we reduce bias due to uncompleted educational biographies.

We will estimate the intergenerational persistence of education between parents and grandparents (generation t-1 and generation t-2) and between children and parents (generation t and t-1). In the intergenerational persistence analysis between grandparents and grandchildren (generation t-2 and t), two equations will be estimated. One that captures the indirect effect of grandparents' schooling on

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grandchildren's schooling that occurs via parents and the other will analyze the direct effect of grandparents' years of schooling on grandchildren's years of schooling, controlling parents' years of schooling.

Figure 1 reports descriptive statistics on the educational attainment of each generation, as well as the range of birth years for each generation. In the database used, there are the years of schooling of generations *t* and *t*-1, however, for generation *t-2* there are schooling categories. In this case, to obtain the years of schooling in the *t-2* generation we attribute values to the different categories of education for grandparents following the study by Mahlmeister et al. (2019) who estimated the intergenerational persistence between two generations for Brazil with the same database (PNAD, 2014). The attributed values to each grandparent's education category are in the Appendix A1.

Grandparents (Generation t-2)
N= 2073
Mean years schooling = 2.83
Standard deviation = 3.76

Parents (Generation t-1)
N= 2260
Mean years schooling = 7.43
Standard deviation = 4.97

Children (Generation t)
N= 2260
Mean years schooling = 11.21
Standard deviation = 4.24

1913*   1923*   1958   1964   1973   1989

Year of birth

– – – – – –   Year of birth of the youngest person in each generation.

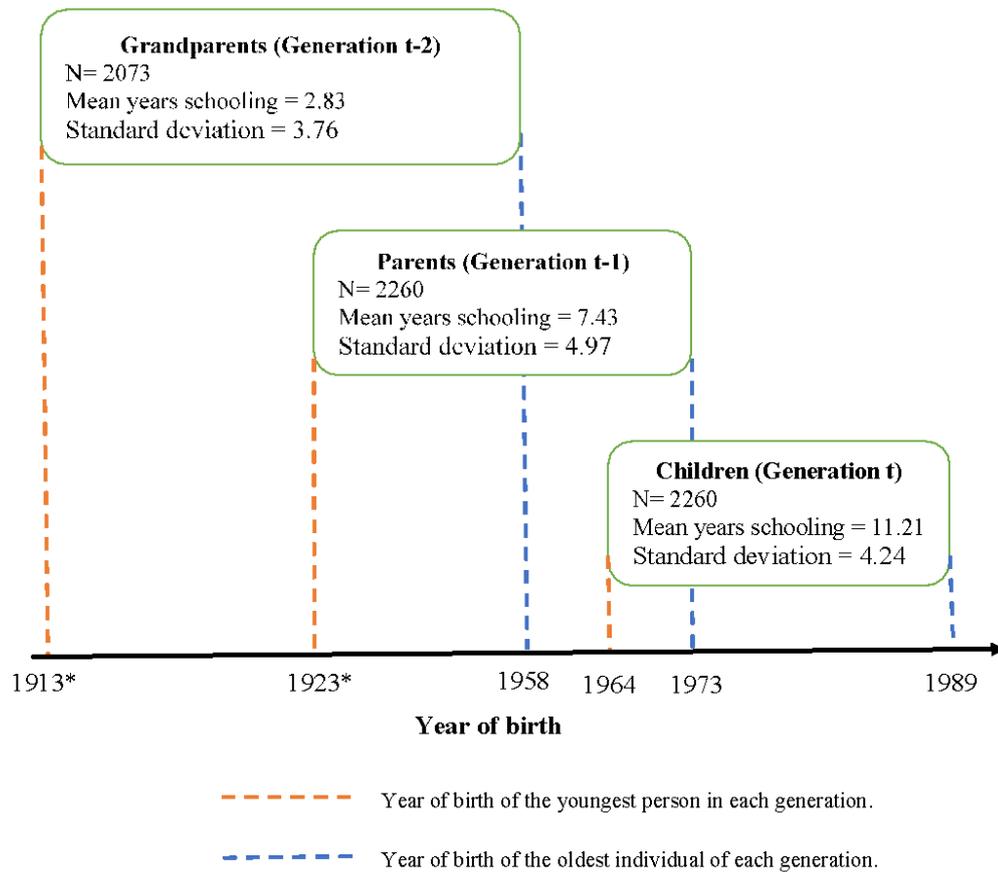– – – – – –   Year of birth of the oldest individual of each generation.

Figure 1. Overview of the generations database
Source: Data set of the 2014 National Household Sample Survey
Note: *Approximate birth year
The horizontal axis shows the spread in birth year for three generations.

In order to present the levels of education reached by the three generations of individuals that were included in the study, graphs 1, 2, and 3 are shown.

Graph 1- Percentage of individuals of each generation by the level of Educational Attainment.
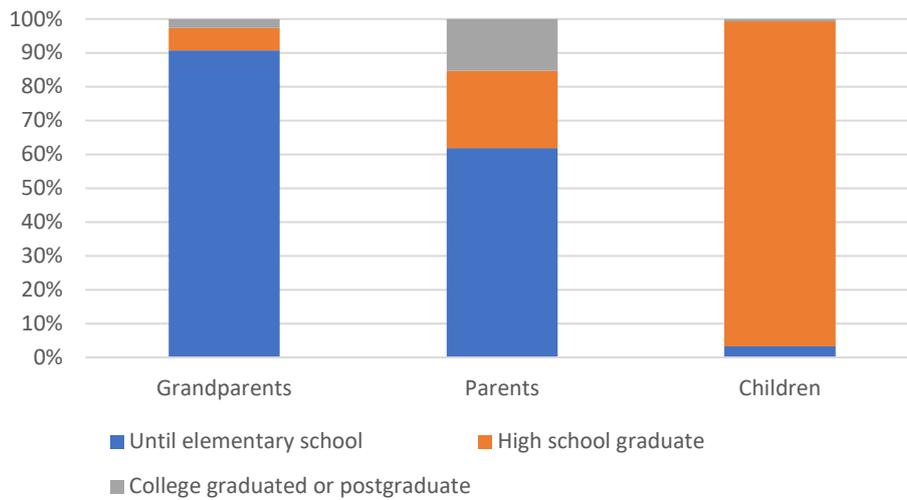
Source: Elaborate by the author based on PNAD data (2014)

3.2 Measuring intergenerational and multigenerational persistence of education

The econometric model widely accepted to the measurement of intergenerational persistence of socioeconomic status is exposed in Equation 1:

$$y_{(it)} = \alpha + \beta . y_{t-x} + \varepsilon_{it} \qquad (1)$$

where $y_{(it)}$ is an outcome indicator of the socioeconomic status of individual i belonging to generation t, and y_{t-x} of her ancestors' outcomes that date back x generations. The coefficient β describes how much of the outcome advantage or disadvantage is transmitted within families over x generations on average. Thus, it can be interpreted as the degree of intergenerational persistence between families over the course of time. From the result of equation 1 it is also possible to obtain measure $1 - \beta$, called the degree of intergenerational mobility (Neidhöfer & Stockhausen, 2018; Mahlmeister et al., 2019).

Since parents are in most families the stronger influential source for the formation of human capital, the association between parents' and children's outcomes is certainly of primary interest. However, although some studies in fact conclude that there is no departure from a first-order AR (1) process, common to estimates of social mobility between two generations, some other studies find that multigenerational links exist over and above the two generations (Solon, 2014, 2018).

Thus, while older studies mostly did not reject the hypothesis that the underlying process of intergenerational transmission of socioeconomic status is of a Markovian nature[4]—in other words, that the socioeconomic status of grandparents and older ancestors is totally mediated by the status of parents—recent studies reject this hypothesis and agree that the iterated extrapolation underestimates the long-run persistence of economic inequality. As Chan and Boliver (2013, p. 3) pointed out, "it is certainly possible that a two-generation, Markovian mobility process operates in some contexts but not in others."

To test for a direct effect due to grandparents, a commonly adopted way to evaluate the statistical association between grandparents and grandchildren, abstracting from the mediating role of parents, is to estimate a regression which includes both the socioeconomic status of parents and grandparents:

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[4] In probability theory and statistics, the term Markov property refers to the memoryless property of a stochastic process. In other words, the probability of being in a specific state at a future time t only depends only on the state of the system right now (s) state and not at all about the states the system has had before (before s). It is named after the Russian mathematician Andrey Markov.

$$y_{(it)} = \alpha + \beta_1 \cdot y_{t-1} + \beta_2 \cdot y_{t-2} + \varepsilon_{it} \qquad (2)$$

A positive significant coefficient of grandparents is often interpreted in the sense that an independent effect due to grandparents persists over and above the effect of parents. Going beyond, a common approach is to include additional variables to control for other socioeconomic characteristics of the parents. In this way, unobserved characteristics that might explain the underlying transmission of status are covered more properly and a positive significant grandparental coefficient is a closer indicator of a direct relationship. However, the grandparental coefficient could still be biased upward due to the omission of other characteristics.

Following this conceptual framework on measuring educational persistence across generations, we initially estimate the persistence between two generations. First, we include the two oldest generations, be these, generation t-1 and generation t-2 (Equation 3), after we follow to generation t and t-1 (Equation 4) and generation t and t-2 (Equation 5). Specifically, we estimate OLS regression models of the following form:

$$Education_{f(t-1)} = \alpha + \beta_1 Education_{f(t-2)} + \varepsilon_{fg} \qquad (3)$$

$$Education_{f(t)} = \alpha + \beta_1 Education_{f(t-1)} + \varepsilon_{fg} \qquad (4)$$

$$Education_{f(t)} = \alpha + \beta_1 Education_{f(t-2)} + \varepsilon_{fg} \qquad (5)$$

Where *Education* refers to the completed years of education of the mentioned generation. For parent (t-1) and grandparent (t-2) we use the highest educational attainment within the family. The β coefficient measures the degree of intergenerational persistence of education and the measure $1 - \beta$ is called the degree of regression to the mean, or degree of mobility intergenerational education.

Subsequently, to measure multigenerational mobility, we estimate a modified version of the intergenerational mobility, which simultaneously includes the parents´ years of schooling (t-1) and grandparents (t-2) as independent variables (Equation 6). Thus, we obtained the direct effect of the grandparent's education on the children's education, that is, the effect of the grandparents' education regardless of the parents' education.

$$Education_{f(t)} = \alpha + \beta_1 Education_{f(t-1)} + \beta_2 Education_{f(t-2)} + \varepsilon_{fg} \qquad (6)$$

As a further robustness check, we also run the complete analysis using the Z-score of educational attainment instead of the completed years of education. This measure is widely used in the literature of educational persistence (Neidhöfer & Stockhausen, 2019; Kroeger & Thompson, 2016) and constitute comparable units across time periods. To convert the years of education variable to a z- score we perform a linear transformation of the relevant outcome variables for grandparents, parents, and children (Equation 7).

$$z_{ijT} = \frac{y_{ijT} - \overline{y_{jT}}}{\sigma_{jT}} \qquad (7)$$

Here, y_{jT} and σ_{jT} are the mean and standard deviation of completed years of education of all individuals from generation $T \in \{t,\ t-1, t-2\}$ in cohort j. The cohort refers to the year of birth of children. This measurement gives the relative standing (in standard deviations) of an individual, and his or her parents and grandparents, with respect to their reference groups.

Advancing the analyses, we also analyze the intergenerational persistence of education considering gender, for the three generations included in our study, for paternal and maternal lineages, according to Figure 2.
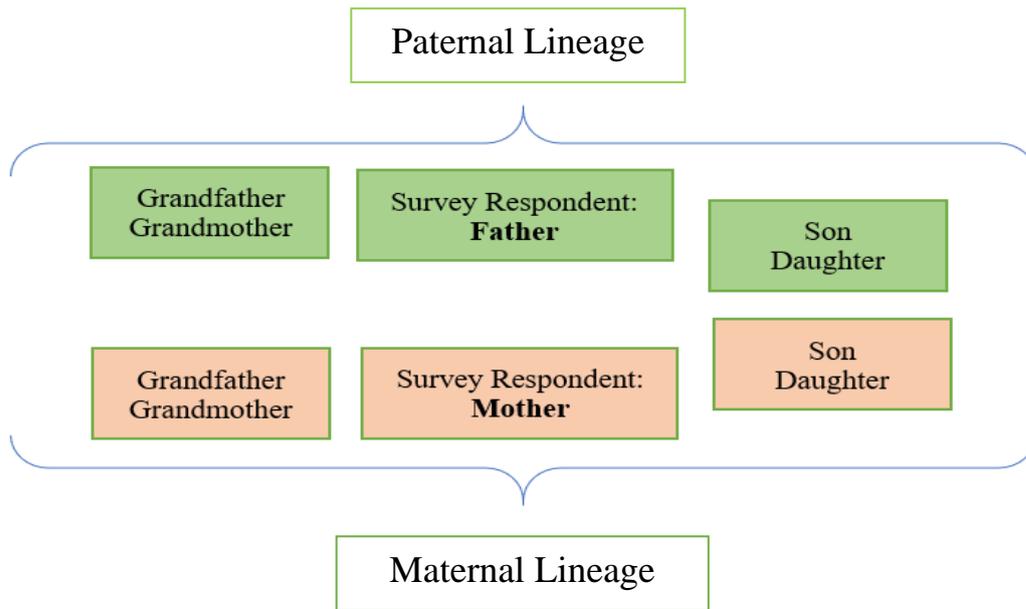
Figure 2. Gender structure of the data.
Source: Celhay & Gallegos (2015)

Additionally, we include an income variable and a race variable separately in the basic regression linear model capturing to test if the presence of a direct and independent effect due to grandparents remains significant. We adopt this additional strategy, because, according to Solon (2014) a positive significant coefficient of grandparents is often interpreted in the sense that an independent effect due to grandparents persists over and above the effect of parents. However, omitted variable bias could explain a positive grandparental coefficient as well. Thus, we can reduce the bias by inserting income and race in the basic model.

4 Results and discussions

4.1 Basic Results

In this section, we present the basic estimates of intergenerational and multigenerational mobility. Table 2, column (1) shows the estimates where we regress parents' education on grandparents' education (Equation 3), and columns (2 and 3) are coefficients of the children's education on parents' and grandparents' education (Equation 4 and 5 respectively). The last column (4) of the table are the regression coefficients of the children's education on both parents' and grandparents' education (Equation 6). As commonly done in the literature, we only consider the education of the parent and grandparent with the highest educational level.

Table 2. Regression Analysis. Outcome: Completed Years of Education

	(1) Parents	(2) Children	(3) Children	(4) Children
	(Generation t-1)	(Generation t)		
Parents (Generation t-1)		0.392*** (0.017)		0.375*** (0.020)
Grandparents (Generation t-2)	0.657*** (0.028)		0.304*** (0.023)	0.058 ** (0.023)
Observations	2,073	2,260	2,073	2,073
R-squared	0.320	0.271	0.148	0.281

Notes: Notes: Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except for generation t-2. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.

The association between the educational attainments of the grandparents (*t-2*) and parents (*t-1*) as given in column (1) shows that there is a persistence of 0.657. In other words, if the grandparent generation has one year of study above the average, the parent generation has an expected value of 0.657 year of study above the average. The regression coefficient of generations t and *t-1* (column 2) is 0.392, shows less educational persistence and a consequently higher degree of intergenerational mobility between more recent generations.

In column 3, the grandparental coefficient is positive and significant (0.304), indicating the indirect effect of grandparents' schooling on children's schooling. This effect can be explained by the fact that increases in longevity have become more common over time the presence and participation of grandparents in the lives of grandchildren, although this is mitigated somewhat by parallel increases in parents' age when having the first child (Giraudeau et al., 2020; Kontis et al., 2017; Geurts et al., 2015; Bol & Kaslmijn, 2016; Deindl & Tieben, 2017). Furthermore, the rise in married women's labor force participation and in the number of single-parent households and stepfamilies have been increasing the demand for care from grandparents, especially in contexts where daycare is scarce or expensive (Giraudeau et al., 2020; Thomese & Liefbroer, 2013; Sorek, 2020; Attar-Schwartz et al., 2009).

Thus, the larger contact between grandparents and grandchildren can directly affect the transfer of the resources, such as money, time, social contacts, and cultural capital. The grandparents can become promoters of traditional values, such as respect and work ethics, having a relevant role in the formation of preferences and attitudes (Coall and Hertwig, 2011; Razzu & Wambile, 2020; Zeng & Xie, 2014; Hertel and Groh-Samberg 2014; Anderson; Sheppard; Monden, 2018; Erickson et al., 2009).

The column 4 indicates a statistically significant direct grandparent effect after conditioning on parent education. However, this effect is weaker than that of parents (0.058), which was expected, according to literature and studies carried out in other countries. The most intuitive channel for grandparent effects is economic resources (Bol & Kalmijn, 2016; Hertel and Groh-Samberg 2014; Anderson; Sheppard; Monden, 2018; Pfeffer, 2014). According to the authors' view, grandchildren can, for example, receive money from their grandparents or inherit money after they die, and this may help the grandchildren to get ahead in university and society. Another form that does not require contact is when grandparents support their adult children financially, they may indirectly assist the schooling outcomes of their grandchildren by improving the standard of living that these grandchildren experience when growing up. Such transfers will have an additive effect and do not depend on the amount of interaction in the family (Bol & Kalmijn, 2016).

Hitherto, we explore the positive points or advantages that can be transmitted by the grandparents for their grandchildren, but in many families, the grandparents have financial constraints, a low level of education and a shortage of cultural and social capital. In such cases, the mechanism that could account for multigenerational processes is structural inequality. It is associated with inadequate healthcare, housing,

and education facilities, limited opportunities for upward mobility, and diminished sociocultural capital and tends to keep the multigenerational disadvantages (Johnson & Kane, 2018; Theron & Van Rensburg, 2018).

As a further robustness check, we perform the same analysis adopting the Z-score of educational attainment (see the Appendices A2-A10). The observed patterns are the same, but the difference in educational persistence between the generation t-1 and t-2 and between the generation t and t-1 is lower. According to Table A1, one additional SD in generations t-2 (equivalent to 3.8 more years of schooling) is associated with 1.9 additional years of schooling for generation t-1. Similarly, one additional SD in generations t-1(equivalent to 5 more years of schooling) is associated with 2.3 additional years of schooling for generation t. The results evidence that absolute mobility increased in Brazil, while relative schooling mobility increased only moderately, as well as the finding in the study of Celhay & Gallegos (2015) for Chile.

4.2 Gender

In this section, we present evidence of the gender role in explaining educational mobility across three generations. We apply the same methodology to study how both sons and daughters are affected by grandparents, along both matrilineal and patrilineal lineage. The results show a stronger association between sons and grandparents than for daughters. Furthermore, we identified a direct effect of grandparents' education (generation t-2) on son's education (generation t) only in the matrilineal lineage.

Therefore, we present in Table 3 the intergenerational persistence of education for the male gender of the generation t, the mother (generation t-1) and maternal grandfather and grandmother (generation t-2). The estimates for daughter-mother-matrilineal grandmother/grandfather and son/daughter- father- patrilineal grandmother/grandfather are in the Appendices.

Table 3. Matrilineal Lineage - Regression analysis by son–mother-grandfather/grandmother. Outcome: Completed years of education

	(1) Mother	(2) Mother	(3) Son	(4) Son	(5) Son	(6) Son	(7) Son
	(Generation t-1)		(Generation t)				
Mother (Generation t-1)			0.411*** (0.033)			0.403*** (0.042)	0.400*** (0.040)
Grandfather (Generation t-2)	0.620*** (0.051)			0.362*** (0.050)		0.102** (0.051)	
Grandmother (Generation t-2)		0.648*** (0.040)			0.408*** (0.054)		0.118** (0.056)
Observations	885	1087	764	512	624	512	624
R-squared	0.270	0.284	0.266	0.168	0.164.	0.321	0.298

Notes: Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except for generation t-2. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.

The first result is that the mother's schooling years are strongly correlated with grandmother's schooling years rather than grandfather's schooling years. If the grandmother generation has one year of study above the average, the mother has an expected value of 0.648 year of study above the average. However, if the grandfather has one year of study above the average, the mother has an expected value of 0.620 year of study above the average.

When we analyze the indirect association between the son's schooling years and the maternal grandparents (columns 4 and 5), it is possible to see a stronger association between the schooling of the son and the grandmother (0.408). We also identified a direct association when we included the mother's schooling in the regression, between the son's schooling years, both with the grandfather and the grandmother, but stronger with the grandmother (0.158).

4.3 Sensibility Analysis

A potential concern is that our results are sensitive to income and race variables because of high income and racial inequality in Brazil. Thus, panel A in Table 4 reports the estimation results, including income as control and Panel b, including race.

Table 4. Testing for a Grandparental Effect. Outcome: Completed years of education. Controlling for Income (Panel A) and Race (Panel B).

Panel A	(1) Parents	(2) Children	(3) Children	(4) Children
	(Generation *t*-1)	(Generation *t*)		
Parents (Generation *t*-1)		0.234*** (0.020)		0.227*** (0.023)
Grandparents (Generation *t-2*)	0.483*** (0.029)		0.154*** (0.023)	0.032 (0.024)
Observations	1,966	2,146	1,966	1,966
R-squared	0.4551	0.336	0.305	0.345
Panel B	(1) Parents	(2) Children	(3) Children	(4) Children
	(Generation *t*-1)	(Generation *t*)		
Parents (Generation *t*-1)		0.362*** (0.017)		0.347*** (0.020)
Grandparents (Generation *t-2*)	0.617*** (0.028)		0.265*** (0.022)	0.051** (0.022)
Observations	2,073	2,260	2,073	2,073
R-squared	0.351	0.287	0.187	0.296

Notes: Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except for generation *t-2*. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.

In Panel A and Panel B, we can identify a decrease in the degree of educational persistence between generations in all estimated regressions. This result demonstrates that according to the families' income and race, the degree of educational persistence changes. The educational persistence between two generations remained significant, controlling by income or race. When we analyze the direct effect of grandparents' education on grandchildren's education, controlling for race, we can see that effect remains significant. However, controlling for income, this effect is no longer significant.

5 Conclusion

This paper has estimated the intergenerational persistence of educational attainment across three generations of Brazilians. We conclude that grandparents' matter and that the intergenerational effects can persist beyond two generations only through matrilineal lineage, for grandsons. We find that the grandmother's and grandfather's educational status directly influences their grandson's educational attainment, over and above the effect transmitted through mother.

Some valid concerns can also be raised about sample construction and the measurement of educational attainment in the PNAD data. For instance, a grandparent's education is reported by the mother or father generation rather than by the grandmother or grandfather themselves. Another concern is that data on three generations can only be constructed when daughters and sons (generation t) are co- residing with their parents. Furthermore, we cannot include both grandparents in the regression because the data is obtained by sampling the middle generation, so only one line of the family is ever observed. Also, we

measure the level of education in the third generation from the age of 25. However, if individuals later entered higher education, they will have the graduated degree eldest and end up becoming an upward educational persistence bias.

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APPENDICES

Appendix A1. Definition of years of schooling for grandparents (generation *t-2*) 0: less than 1 year of study; 2: completed the first, second or third grade of elementary school, but did not complete the fourth; 4: completed the fourth grade; 6: completed the fifth, sixth or seventh series, but did not complete the eighth; 8: completed the eighth grade; 10: incomplete high school; 11: completed high school; 13: attended but did not complete higher education; and 16: completed higher education.

Appendix A2. Regression Analysis. Outcome: Z-Score of Educational Attainment

	(1) Parents	(2) Children	(3) Children	(4) Children
	(Generation *t*-1)		(Generation *t*)	
Parents		0.460***		0.439***
(Generation *t*-1)		(0.020)		(0.024)
Grandparents	0.497***		0.269***	0.051**
(Generation *t-2*)	(0.022)		(0.020)	(0.020)
Observations	2,073	2,260	2073	2,073
R-squared	0.320	0.271	0.148	0.281

Notes: Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except of generation *t-2*. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.

Appendix A3. Patrilineal Lineage - Regression analysis by son–father-paternal grandfather and grandmother. Outcome: Completed years of education

	(1) Father	(2) Father	(3) Son	(4) Son	(5) Son	(6) Son	(7) Son
	(Generation *t*-1)		(Generation *t*)				
Father			0.438 ***			0.420***	0.447***
(Generation *t*-1)			(0.032)			(0.045)	(0.041)
Grandfather	0.736***			0.350***		0.023	
(Generation *t-2*)	(0.047)			(0.048)		(0.046)	
Grandmother		0.823***			0.383***		-0.004
(Generation *t-2*)		(0.048)			(0.050)		(0.046)
Observations	682	748	547	402	447	402	447
R-squared	0.361	0.363	0.354	0.222	0.185	0.389	0.360

Notes: Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except of generation *t-2*. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.

Appendix A4. Patrilineal Lineage - Regression analysis by daughter–father-paternal grandfather and grandmother. Outcome: Completed years of education

	(8) Daughter	(9) Daughter	(10) Daughter	(11) Daughter	(12) Daughter
			(Generation t)		
Father (Generation t-1)	0.298*** (0.032)			0.286*** (0.033)	0.277*** (0.040)
Grandfather (Generation t-2)		0.230*** (0.049)		0.033 (0.043)	
Grandmother (Generation t-2)			0.295*** (0.055)		0.082 (0.052)
Observations	374	280	301	280	301
R-squared	0.229	0.108	0.145	0.221	0.242

Notes: Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except of generation t-2. PNAD custom sampling weights are applied. Statistical significance levels: *$p < .10$, **$p < .05$, ***$p < .01$

Appendix A5. Patrilineal Lineage - Regression analysis by son–father-paternal grandfather and grandmother. Outcome: Z-Score of Educational Attainment

	(1) Father	(2) Father	(3) Son	(4) Son	(5) Son	(6) Son	(7) Son
	(Generation t-1)				(Generation t)		
Father (Generation t-1)			0.510*** (0.038)			0.489*** (0.053)	0.521*** (0.047)
Paternal grandfather (Generation t-2)	0.557*** (0.036)			0.308*** (0.043)		0.020 (0.040)	
Paternal grandmother (Generation t-2)		0.559*** (0.033)			0.303*** (0.039)		-0.003 (0.036)
Observations	682	748	547	402	447	402	447
R-squared	0.361	0.363	0.354	0.222	0.185	0.389	0.360

Notes: Column headings indicate the dependent variable. Educational attainment is measured using z-scores, and the reported coefficients can therefore be interpreted in standard deviation units. All models contain full sets of birth year for the relevant individuals, except of generation t-1. Robust standard errors are in parentheses. PNAD custom sampling weights are applied.

Appendix A6. Patrilineal Lineage - Regression analysis by daughter–father-paternal grandfather and grandmother. Outcome: Z-Score of Educational Attainment

	(8) Daughter	(9) Daughter	(10) Daughter	(11) Daughter	(12) Daughter
			(Generation t)		
Father	0.412***			0.396***	0.383***
(Generation t-1)	(0.045)			(0.052)	(0.056)
Paternal grandfather		0.240***		0.034	
(Generation t-2)		(0.052)		(0.045)	
Paternal grandmother			0.277***		0.077
(Generation t-2)			(0.052)		(0.049)
Observations	374	280	301	280	301
R-squared	0.230	0.108	0.145	0.221	0.242

Notes: Column headings indicate the dependent variable. Educational attainment is measured using z-scores, and the reported coefficients can therefore be interpreted in standard deviation units. All models contain full sets of birth year for the relevant individuals, except of generation t-1. Robust standard errors are in parentheses. PNAD custom sampling weights are applied.

Appendix A7. Matrilineal Lineage - Regression analysis by daughter–mother-grandfather/grandmother. Outcome: Completed years of education

	(8) Daughter	(9) Daughter	(10) Daughter	(11) Daughter	(12) Daughter
			(Generation t)		
Mother (Generation t-1)	0. 330***			0.298***	0.303***
	(0.030)			(0.042)	(0.040)
Grandfather		0.266***		0.087	
(Generation t-2)		(0.068)		(0.062)	
Grandmother			0.256***		0.082
(Generation t-2)			(0.045)		(0.053)
Observations	575	373	463	373	463
R-squared	0.225	0.153	0.095	0.290	0.225

Notes: Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except of generation t-2. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.

Appendix A8. Matrilineal Lineage - Regression analysis by son–mother grandfather/grandmother. Outcome: Z-Score of Educational Attainment

	(1) Mother	(2) Mother	(3) Son	(4) Son	(5) Son	(6) Son	(7) Son
	(Generation t-1)		(Generation t)				
Mother (Generation t-1)			0.458*** (0.037)			0.449*** (0.047)	0.445*** (0.044)
Maternal grandfather (Generation t-2)	0.455*** (0.037)			0.296*** (0.041)		0.084** (0.042)	
Maternal grandmother (Generation t-2)		0.429*** (0.026)			0.300*** (0.039)		0.087** (0.042)
Observations	885	1087	764	512	624	512	624
R-squared	0.270	0.284	0.266	0.168	0.164	0.321	0.298

Notes: Column headings indicate the dependent variable. Educational attainment is measured using z-scores, and the reported coefficients can therefore be interpreted in standard deviation units. Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except of generation t-2. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.

Appendix A9. Matrilineal Lineage - Regression analysis by daughter–mother-grandfather/grandmother. Outcome: Z-Score of Educational Attainment

	(8) Daughter	(9) Daughter	(10) Daughter	(11) Daughter	(12) Daughter
	(Generation t)				
Mother (Generation t -1)	0.437*** (0.040)			0.395*** (0.055)	0.401*** (0.053)
Maternal grandfather (Generation t-2)		0.258*** (0.066)		0.085 (0.060)	
Maternal grandmother (Generation t-2)			0.224*** (0.039)		0.071 (0.046)
Observations	575	373	463	373	463
R-squared	0.225	0.153	0.095	0.289	0.225

Notes: Column headings indicate the dependent variable. Educational attainment is measured using z-scores, and the reported coefficients can therefore be interpreted in standard deviation units. All models contain full sets of birth year for the relevant individuals, except of generation t-1. Robust standard errors are in parentheses. PNAD custom sampling weights are applied.

Appendix A10. Testing for a Grandparental Effect. Outcome: Z-Score of Educational Attainment. Controlling for Income (Panel A) and Race (Panel B).

	(1) Parents	(2) Children	(3) Children	(4) Children
PANEL A				
	(Generation *t*-1)	(Generation *t*)		
Parents (Generation *t*-1)		0.274*** (0.024)		0.266*** (0.027)
Grandparents (Generation *t*-2)	0.365*** (0.022)		0.129*** (0.020)	0.028 (0.021)
Observations	1,966	2,146	1,966	1,966
R-squared	0.455	0.336	0.305	0.345
PANEL B	(1) Parents	(2) Children	(3) Children	(4) Children
	(Generation *t*-1)	(Generation *t*)		
Parents (Generation *t*-1)		0.423*** (0.020)		0.407*** (0.024)
Grandparents (Generation *t*-2)	0.467*** (0.021)		0.235*** (0.020)	0.046** (0.020)
Observations	2,073	2,260	2,073	2,073
R-squared	0.351	0.287	0.187	0.296

Notes: Column headings indicate the dependent variable. Robust standard errors in parentheses clustered at the family level. All models contain full sets of birth year for the relevant individuals, except of generation *t-2*. PNAD custom sampling weights are applied. Statistical significance levels: *p < .10, **p < .05, ***p < .01.