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ARTICLE

Intergenerational educational mobility, discrimination, and hypertension in adults from Southern Brazil

Mobilidade educacional intergeracional, discriminação e hipertensão arterial em adultos do Sul do Brasil

Movilidad educacional intergeneracional, discriminación e hipertensión arterial en adultos del Sur de Brasil

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Abstract

Systemic arterial hypertension (SAH) or high blood pressure a serious global public health problem marked by social inequalities. There are few studies on SAH in Brazil with a life-course theoretical perspective. The current article aims to analyze the relationship between intergenerational educational mobility (IEM) and SAH in Brazilian adults, verifying the impact of interpersonal and color/"race" discrimination on this relationship. The authors analyzed data from 1,720 adults (20-59 years) and their parents in the EpiFloripa Adult Study. Random-effects multilevel regression models were estimated. The fixed effects showed an inverse relationship between IEM and odds of SAH, with statistical significance for high IEM (paternal model: OR = 0.39, p = 0.006; maternal model: OR = 0.35, p = 0.002; and family model: OR = 0.35, p = 0.001). Meanwhile, interaction models showed that situations of discrimination can act jointly with unfavorable IEM, increasing the odds of SAH, especially among black and brown individuals. The study concludes that persistently high IEM is capable of significantly reducing the odds of SAH, while discrimination can intensify the effect of low education, especially in socially marginalized population segments.

Social Inequity; Cardiovascular Diseases; Racism; Social Mobility; Multilevel Analysis

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Introduction

Systemic arterial hypertension (SAH) or high blood pressure is a chronic noncommunicable disease, frequently asymptomatic, considered a leading risk factor for cardiovascular diseases. SAH is defined as systematic systolic/diastolic levels greater than or equal to 140/90mmHg [1].

The occurrence of SAH has often been linked to social inequalities [2,3]. Although prevalence of the disease tends to decrease in many wealthy countries, it has increased in low and middle-income nations [3]. SAH affects approximately 30% of the adult population in Brazil [4]. In this context, SAH has been associated with various indicators of socioeconomic status, such as occupation, income and education [2]. Among these, education has shown a strong inverse association with SAH in Brazil [4,5,6]. Most of the evidence for this association between schooling and SAH in Brazil has come from cross-sectional studies [5,6].

Inequalities in SAH have also appeared in relation to color, ethnicity, or "race". The disease is more prevalent among individuals classified as black or brown when compared to whites [6,7]. The literature has suggested that ethnic and racial inequalities in SAH reflect unfavorable social conditions related to interpersonal discrimination and structural racism rather than biological differences between whites and blacks [6,8].

The current article thus aims to analyze the relationship between intergenerational educational mobility (IEM) and SAH in a sample of Brazilian adults. We also aim to verify the role of interpersonal and racial discrimination as effect modifiers in the relationship between IEM and SAH. The goal is to contribute to the understanding of inequalities in SAH in low and middle-income countries and thus better orient public policies aimed at promoting the health of socially excluded or marginalized populations.

Educational mobility, discrimination, and hypertension in Brazil

Life-course epidemiology is the study of long-term biological, behavioral, and psychosocial processes that link health risk in adults to physical or social exposures during intrauterine life, childhood, adolescence, and early adulthood or events transmitted across generations [9].

The social mobility model is important here, considering that individuals' health can be influenced by variation in their life-course social status, including upward or downward social mobility as well as persistence in the same position for indeterminate periods. Such variation can occur both within the same generation (intragenerational) and across different generations (intergenerational) [10].

Social inequalities persist in Brazil, as in other low and middle-income countries [11]. Analyses of intergenerational mobility suggest a tendency for individuals to remain in certain socioeconomic strata, especially at the low and high social extremes [12]. Besides, even in the presence of upward mobility, the "leap" by underprivileged individuals in relation to their parents proves insufficient to guarantee material equality with the better-off portion of the population [13].

Despite the inverse association between schooling and SAH [5,6], little is known about the relationship between this health outcome and IEM in Brazil. Only one Brazilian study was found, but it was limited to an analysis of intragenerational social mobility and SAH, and no statistically significant association was observed [14].

The pattern of educational levels across generations in Brazil also exhibits inequalities according to color, ethnicity, or "race". The likelihood of black and brown Brazilians remaining at low levels of education is greater than for whites [13,15]. According to various authors, this "racial" inequality in education reflects interpersonal discrimination and structural racism, part of the country's historical trajectory based on slavery and the power relations established during Brazil's colonial period [16].

Considering that Brazil is a country with intense and persistent social inequalities and with a significant black and brown population, where SAH is a public health problem, more studies on the link between discrimination and the socioeconomic disadvantages that affect the population's blood pressure are extremely important.

Methods

Participants

We analyzed data from 1,720 participants in the EpiFloripa Adult Study (ages 20-59 years at baseline). The study began in 2009, with the first follow-up wave in 2012 (n = 1,222) and the third in 2014 (n = 862). In 2009 and 2012, the interviews were held at the participants' homes, in the urban area of Florianópolis, capital of the state of Santa Catarina in southern Brazil. Sampling was done in two-stage clusters, with the first involving selection of census tracts according to head-of-household's income deciles, constituting the primary analytical units. The second stage was the selection of households for the home visits. Pregnant women in the second or third trimester and women with infants six months of age or younger did not have their blood pressure measured or anthropometric measures taken. In the last wave, participants went to a center organized for the data collection and measurements. In all three waves, blood pressure was measured two to three times, using a digital pulse sphygmomanometer. The questionnaire applied in 2009 included questions on the participants' schooling, prior diagnosis of SAH, and use of antihypertensive medication. In the 2012 wave, data were collected on parents' education, besides information on experiences with discrimination at the individual level. In 2014, data were collected again on the participants' schooling.

The Institutional Review Board of the Federal University of Santa Catarina approved the study under protocols 351/08 of December 15, 2008, and 1772/11 of February 28, 2011. Participants signed a free and informed consent form after receiving an explanation on the study's objectives. Details on the baseline methodological procedures of the EpiFloripa Adult Study have been described in a previous publication [17].

Dependent variable

Individuals were classified as hypertense with systolic/diastolic blood pressure greater than or equal to 140/90mmHg [1] and/or when they reported a medical diagnosis of SAH and use of antihypertensive medication. Considering the participants' follow-up over time at three different data collection moments, the dependent variable was defined as the presence of hypertension (yes/no) on at least one of the three occasions. The specific analysis of incident cases of hypertension is the object of another study under way and will be published in due course.

Exposures

Years of schooling were used as an indicator of socioeconomic status both for the participants (current socioeconomic status) and for their parents (parents' socioeconomic status during the participants' childhood, hereinafter "childhood socioeconomic status"). Education is a widely used indicator for socioeconomic status in epidemiological studies, since it is generally available for both sexes; it is also a quantifiable measure and especially is more stable over time when compared to occupation and income [18].

IEM was calculated as the variation between current socioeconomic status and childhood socioeconomic status. Three types of IEM were calculated: paternal education, maternal education, and family education. Family IEM was created on the basis of greater mobility between paternal and maternal IEM. Thus, when paternal mobility was low and maternal mobility was downward, the resulting family IEM variable consisted of maternal mobility. When paternal mobility was upward and maternal mobility was downward, the family IEM reflected paternal mobility, and so on.

The categories for the IEM variable were thus as follows: low (for participants with low schooling and whose parents likewise had low schooling), high (for individuals and parents with high schooling), upward (for participants with high schooling, as opposed to their parents), and downward (for individuals in this study with less schooling than their own parents). Categorization of socioeconomic status variables was based on the division of educational levels in Brazil: primary schooling (0-9 years), secondary (10-12 years), and university (> 12 years) [19]. This division was adopted in Brazil in 1996. Previously, secondary school ended with 11 years of schooling. In order to reduce classification

errors, individuals under 30 years of age, i.e., who were 16 years or younger in 1996, were classified according to the new division, while those 30 years or older, or 17 years or older in 1996, were classified according to the previous division.

Some authors contend that social processes involved in the transition from primary to secondary school have less impact than the transition from secondary school to university, when individuals receive a greater load of responsibilities, often starting life away from their parents and dealing with new situations and health risks [20]. Primary and secondary schooling were thus condensed into one socioeconomic status category, "low". University education was defined as the "high" category of socioeconomic status.

As for childhood socioeconomic status, the study took into account the improvement in education in Brazil in recent decades [21]. Thus, childhood socioeconomic status was categorized according to the parents' median years of schooling in relation to the study participant's age. Parents with schooling below the median for the participants' age were classified as having low education. Parents with schooling above the median for the participants' age were classified as having high education.

Confounding and interaction variables

The confounding variables sex, age (20-29, 30-39, 40-49, ≥ 50 years), and total household income (quintiles) were tested in the procedure for definition of the final models, since the literature suggests a frequent association between them and the target variables [2,22]. The analyses were also adjusted for the effect of the time transpired between the waves. Interpersonal discrimination was measured with the *Everyday Discrimination Scale* (EDS), which allows analyzing unfair treatments over the course of life in different domains, as well as the reasons for discrimination and the study participant's classification of a given event as discriminatory or non-discriminatory. The EDS was drafted to assess the effects of discrimination on health outcomes and behaviors [23]. Skin color/"race" was assigned according to visual inspection by the interviewer, because as some authors suggest [24], this reflects how participants are "perceived" by others. This process can also be called physiognomy and refers to a judgment based on appearance, which can determine the degree of exposure to health risks [24].

Statistical analyses

Multilevel analyses were performed with Stata 14 software (https://www.stata.com), using *generalized linear latent and mixed models* (GLLAMM) to obtain the random intercept and coefficient with dichotomous outcome (with/without SAH). The final multilevel models were defined by the forward strategy ($p < 0.05$), inserting each of the confounding variables (sex, age, income, and time between study waves) and interaction variables (interpersonal discrimination and skin color/race) sequentially, comparing the nested models using the maximum likelihood test. Analysis of the GLLAMM with and without a random gradient was also performed. Interaction between discrimination and IEM was tested in stratified analysis by skin color/race, creating a new variable resulting from the multiplication of interpersonal discrimination (dichotomous) and IEM (polytomous). These interaction models considered the role of discrimination on racial inequalities in education [13] and their connection to blood pressure in adults [6,7]. The test hypothesis took into account that the effect of IEM could be intensified in situations of interpersonal discrimination, especially for black and brown Brazilians. All the statistical analysis took the study's sampling structure and weights into account.

Results

The study sample was mostly female, under 40 years of age, in the fourth quintile of total household income, and with low current and childhood socieconomic status. The losses were due mainly to participants having moved to other cities, not being found at home, or having refused to remain in the study. Table 1 shows the participants' distribution according to baseline sociodemographic characteristics (2009), including the report of lifetime experiences with discrimination (2012) and prevalence of SAH. Higher prevalence of SAH was seen in men, individuals over 50 years of age, those classified

Table 1

Description of the sample according to sociodemographic characteristics and prevalence of hypertension. Florianópolis, Santa Catarina State, Brazil, 2009.

Variables	Total (n = 1,720)	Hypertension		
	%	%	95%CI	p-value *
Sex				
Female	56.03	36.48	33.41; 39.65	< 0.001
Male	43.97	55.36	51.76; 58.90	
Age (years)				
20-29	30.36	32.89	28.94; 37.10	< 0.001
30-39	22.43	38.35	33.53; 43.42	
40-49	26.39	50.43	45.72; 55.13	
50+	20.82	61.69	56.41; 66.72	
Skin color/"Race"				
Black and brown	10.51	51.35	44.04; 58.60	0.067
White	89.49	44.11	41.60; 46.66	
Discrimination (n = 1,183) **				
No	46.11	46.95	42.73; 51.22	0.941
Yes	53.89	46.97	43.05; 50.93	
Total household income				
1st quintile	19.88	45.24	39.92; 50.66	0.190
2nd quintile	19.92	47.71	42.28; 53.19	
3rd quintile	20.66	47.93	42.56; 53.35	
4th quintile	22.35	43.27	38.24; 48.43	
5th quintile	17.16	39.04	33.53; 44.85	
Current education (aSES)				
Low	58.83	50.08	46.95;53.22	< 0.001
High	41.17	37.38	33.81; 41.10	
Childhood education (cSES) **				
Paternal education				
Low (≤ median years of schooling)	55.07	45.24	41.11; 49.44	0.778
High (> median years of schooling)	44.93	44.17	39.58; 48.87	
Maternal education				
Low (≤ median years of schooling)	54.91	46.02	41.97; 50.13	0.833
High (> median years of schooling)	45.09	45.94	41.40; 50.55	
Family education ***				
Low (≤ median years of schooling)	48.61	47.48	43.27; 51.73	0.443
High (> median years of schooling)	51.39	45.40	41.28; 49.58	
IEM				
Paternal				
Low (low→low)	36.31	47.31	42.19; 52.50	< 0.001
Downward (high→low)	15.30	57.28	49.16; 65.03	
Upward (low→high)	18.83	41.53	34.63; 48.80	
High (high→high)	29.56	37.21	31.78; 42.98	
Maternal				
Low (low→low)	37.19	47.82	42.87; 52.80	< 0.001
Downward (high→low)	15.50	60.56	52.55; 68.03	
Upward (low→high)	17.79	42.56	35.53; 49.90	
High (high→high)	29.53	38.24	32.88; 43.90	

(continues)

Table 1 (continued)

Variables	Total (n = 1,720)	Hypertension		
	%	%	95%CI	p-value *
Family				
Low (low→low)	35.77	49.21	44.28; 54.15	< 0.001
Downward (high→low)	18.93	58.09	51.11; 64.75	
Upward (low→high)	12.88	43.04	34.99; 51.47	
High (high→high)	32.43	37.94	32.97; 43.17	

95%CI: 95% confidence interrval; aSES: socioeconomic status in adulthood; cSES: socioeconomic status in childhood; IEM: intergenerational educational mobility.

* Pearson's chi-square test for comparison of hypertension prevalence between categories of sociodemographic variables;

** Year 2012;

*** Most favorable mobility between the parents.

as black or brown, in the third income quintile, with low childhood and current SES, and with downward and low IEM. Prevalence of SAH was similar between individuals reporting discrimination and those not reporting it.

Comparisons of models with and without random coefficients did not provide additional information with the gradient's inclusion, so we opted for models with the random intercept only. Three final models were selected, hierarchically testing the life-course effect of IEM on SAH. The multilevel analysis with random effects showed that the influence of IEM was maintained even after adjusting for confounding, as shown in Table 2. Constantly low socioeconomic status across generations (low IEM) was considered the reference category. Downward IEM increased the odds of SAH. This pattern was observed in models 1, 2, and model 3. In the opposite direction, upward IEM reduced the odds of SAH, both when paternal mobility was tested (model 1), as well as maternal mobility (model 2) and family mobility (model 3). Persistently high socioeconomic status across generations (high IEM) significantly reduced the odds of SAH in all the models. In Table 2, considering the influence of random effects, not measured by the study variables, intraclass correlations (ICCs) for the random intercepts in the three models (0.91) indicated high propensity for the participants to remain in their initial socioeconomic status throughout the study, due to individual characteristics. Age, sex, and follow-up time all showed high influence on the odds of SAH.

In the analysis of the interaction between discrimination and IEM, the group that did not report discrimination was considered the reference category. As shown in Table 3, the inverse relationship between IEM and presence of SAH was maintained in individuals that reported discrimination when compared to those with no such report. In practically all of the interaction models tested, the odds of SAH increased in low and downward IEM among individuals that reported discrimination compared to those not reporting it, except in the paternal model's downward category. In the three models, individuals reporting discrimination showed lower odds of SAH in upward and high IEM, and the results in the high category were statistically significant.

However, analyzing the interaction between IEM and discrimination graphically, the above-mentioned inverse tendency practically disappeared. There was a reduction in the odds of SAH in nearly all the IEM categories when discrimination was reported, and this was repeated in all three models tested (Figures 1a, 1b, and 1c). The only exceptions were in the downward category in the maternal model (Figure 1a) and family model (Figure 1c).

Table 2

Generalized Linear Latent and Mixed Models for testing the association between independent target variables and hypertension. Florianópolis, Santa Catarina State, Brazil, 2009, 2012 and 2014.

	Hypertension								
	Model 1 (Father)			Model 2 (Mother)			Model 3 (Family)		
	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Fixed effects									
Mobility of scocioeconomic status									
Low (low→low)	1.00	-	-	1.00	-	-	1.00	-	-
Downward (high→low)	1.13	0.44; 2.91	0.797	1.50	0.57; 3.95	0.412	1.14	049; 2.64	0.757
Upward (low→high)	0.72	0.32; 1.62	0.432	0.82	0.37; 1.80	0.623	0.86	0.36; 2.02	0.724
High (high→high)	0.39	0.20; 0.76	0.006	0.35	0.18; 0.69	0.002	0.35	0.19; 0.66	0.001
Discrimination									
No	1.00	-	-	1.00	-	-	1.00	-	-
Yes	1.22	0.67; 2.20	0.519	1.28	0.72; 2.26	0.395	1.26	0.71; 2.24	0.430
Skin color/"Race"									
Black and brown	1.00	-	-	1.00	-	-	1.00	-	-
White	0.47	0.17; 1.26	0.134	0.44	0.18; 1.12	0.085	0.45	0.18; 1.16	0.098
Sex									
Female	1.00	-	-	1.00	-	-	1.00	-	-
Male	81.73	25.60; 260.95	< 0.001	88.41	28.35; 275.69	< 0.001	87.04	28.29; 267.75	< 0.001
Age (years)									
20-29	1.00	-	-	1.00	-	-	1.00	-	-
30-39	23.93	4.98; 114.92	< 0.001	26.97	6.06; 120.10	< 0.001	27.74	6.32; 121.75	< 0.001
40-49	32.22	7.65; 135.59	< 0.001	35.52	9.08; 138.92	< 0.001	36.57	9.61; 139.22	< 0.001
50+	110.49	23.92; 510.38	< 0.001	122.02	28.71; 518.45	< 0.001	122.60	29.58; 508.14	< 0.001
Time	1.18	1.13; 1.24	< 0.001	1.18	1.13; 1.24	< 0.001	1.18	1.13; 1.24	< 0.001
Intercept *	0.01	0.00; 0.46	< 0.001	0.01	0.00; 0.04	< 0.001	0.01	0.00; 0.042	< 0.001
**Random effects ** **									
Intercept									
Variance		32.51			33.31			33.37	
ICC		0.91			0.91			0.91	
Log-likelihood		-239.12			-239.18			-239.05	

95%CI: 95% confidence interval; ICC: intraclass correlation; OR: odds ratio.

* Regression intercept;

** Variance at the individual level.

Stratifying the analyses by skin color/ "race", no effect modification was seen in the maternal model when comparing black or brown individuals to whites (Figure 2). However, in the paternal model (Figure 3) and family model (Figure 4), the odds of SAH differed between black/brown individuals and whites in low and downward IEM. Meanwhile, in the paternal model, the odds of SAH increased among black or brown individuals who reported discrimination in low and downward IEM, while the odds decreased in white individuals in the same situation. In the family model, the odds of SAH did not vary in the low category and increased in the downward category among black or brown individuals reporting discrimination, compared to those not reporting it, but decreased in whites in the same situation in the low and downward categories. In upward and high IEM, the odds of SAH were lower among those who reported discrimination in all the models and between black or brown individuals and whites.

Table 3

Generalized Linear Latent and Mixed Models for examination of the association between independent target variables and interaction with hypertension. Florianópolis. Santa Catarina State, Brazil, 2009, 2012 and 2014.

	Hypertension								
	Model 4 (Father)			Model 5 (Mother)			Model 6 (Family)		
	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Fixed effects									
IEM X Discrimination									
Non-discriminated	1.00	-	-	1.00	-	-	1.00	-	-
Discriminated									
Low (low→low)	1.42	0.62; 3.23	0.403	1.31	0.57; 3.02	0.526	1.29	0.57; 2.91	0.533
Downward (high→low)	0.89	0.27; 2.96	0.851	1.90	0.53; 6.83	0.325	1.60	0.50; 5.08	0.425
Upward (low→high)	0.45	0.18; 1.11	0.082	0.64	0.28; 1.47	0.295	0.65	0.26; 1.66	0.371
High (high→high)	0,40	0.18; 0.87	0.022	0.34	0.16; 0.74	0.007	0.36	0.18; 0.73	0.005
Skin color/"Race"									
Black and brown	1.00	-	-	1.00	-	-	1.00	-	-
White	0.55	0.15; 2.05	0.376	0.51	0.18; 1.39	0.187	0.50	0.18; 1.41	0.191
Sex									
Female	1.00	-	-	1.00	-	-	1.00	-	-
Male	98.69	28.29; 344.34	< 0.001	103.97	29.06; 371.94	< 0.001	101.38	28.76; 357.38	< 0.001
Age (years)									
20-29	1.00	-	-	1.00	-	-	1.00	-	-
30-39	26.60	5.13; 137.95	< 0.001	27.55	5.61; 135.24	< 0.001	27.38	5.56; 134.73	< 0.001
40-49	39.39	9.61; 161.42	< 0.001	40.43	9.66; 169.19	< 0.001	39.86	9.68; 164.15	< 0.001
50+	141.17	34.01; 586.03	< 0.001	139.97	33.41; 579.81	< 0.001	138.17	33.37; 572.05	< 0.001
Time	1.19	1.13; 1.25	< 0.001	1.19	1.13; 1.25	< 0.001	1.19	1.13; 1.25	< 0.001
Intercept *	0.00	0.00; 0.03	< 0.001	0.00	0.00; 0.33	< 0.001	0.00	0.00; 0.03	< 0.001
**Random effects ** **									
Intercept									
Variance		33.23			33.34			33.20	
ICC		0.91			0.91			0.91	
Log-likelihood		-240.63			-240.51			-240.53	

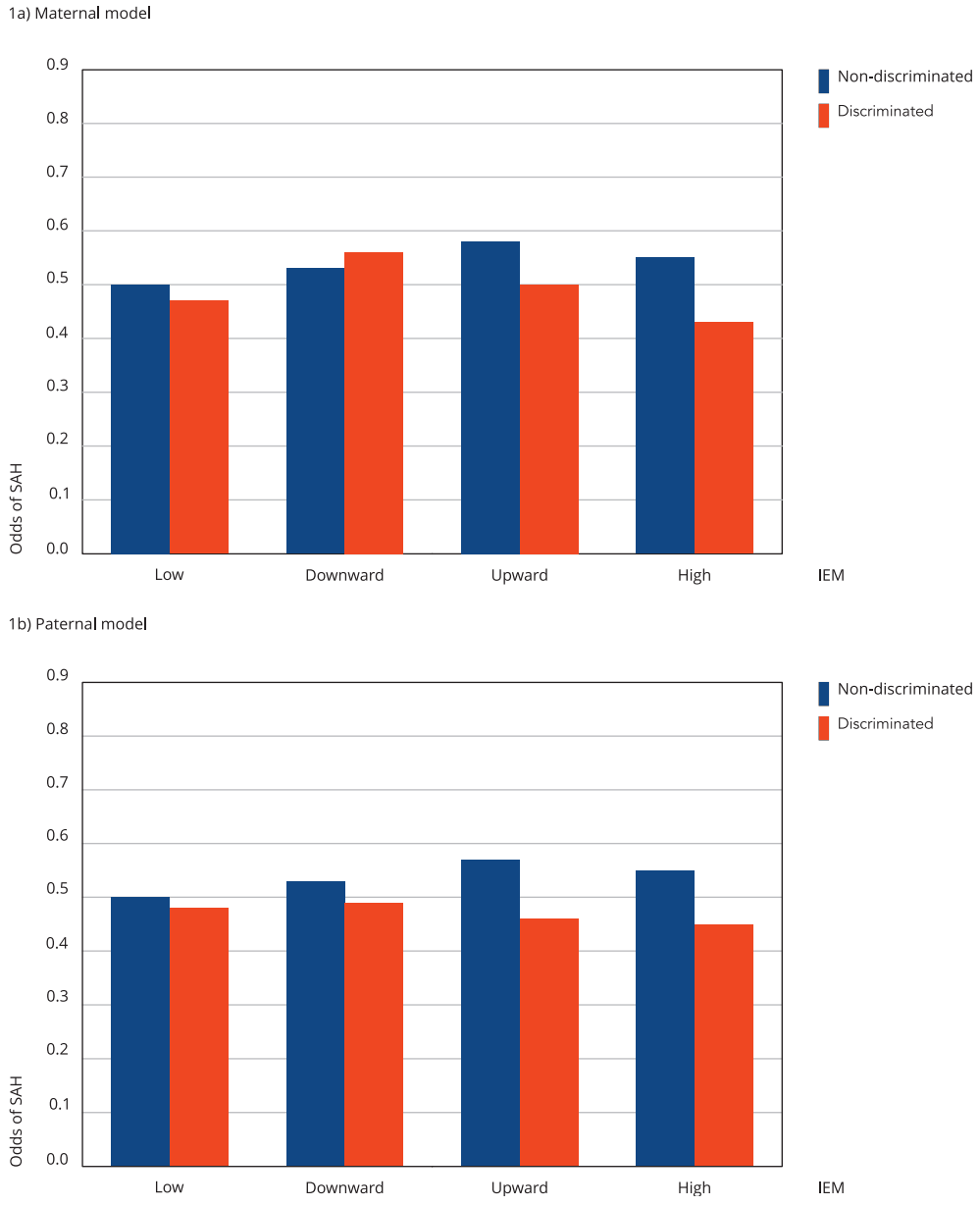
95%CI: 95% confidence interval; ICC: intraclass correlation; IEM: intergenerational educational mobility; OR: odds ratio.

* Regression intercept;

** Variance at the individual level.

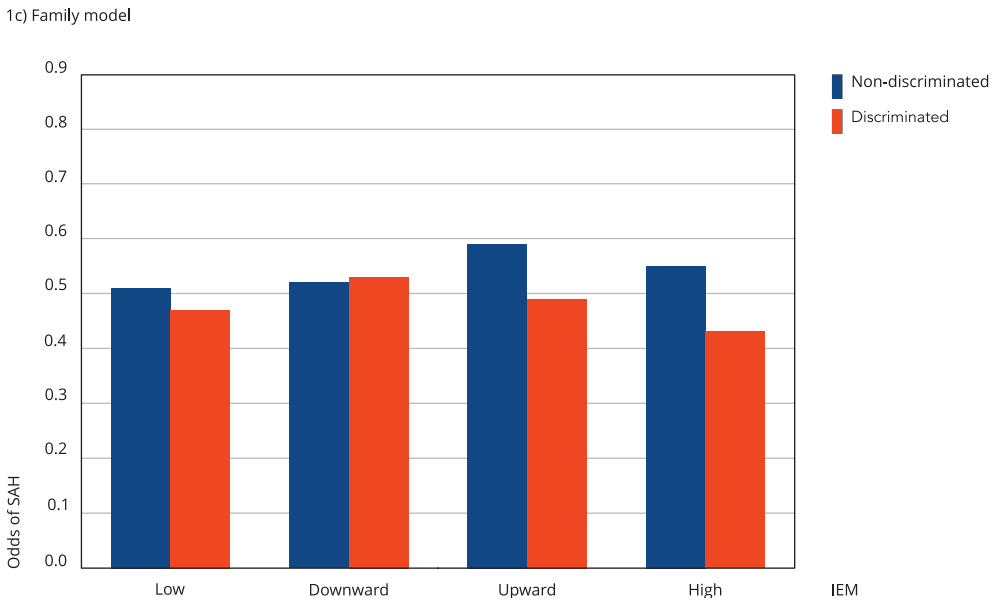
Figure 1

Analyses of interaction between discrimination and intergenerational educational mobility (IEM).



(continues)

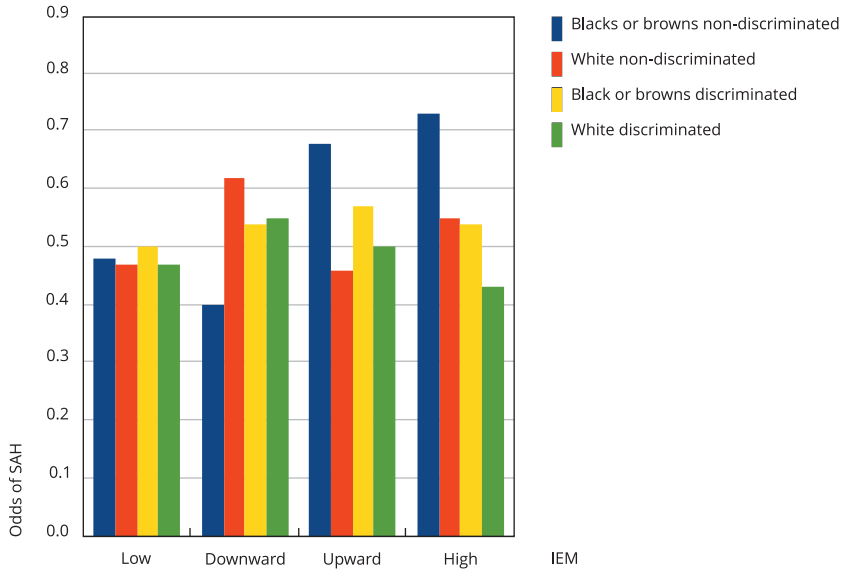
Figure 1 (continued)



SAH: systolic arterial hypertension.

Figure 2

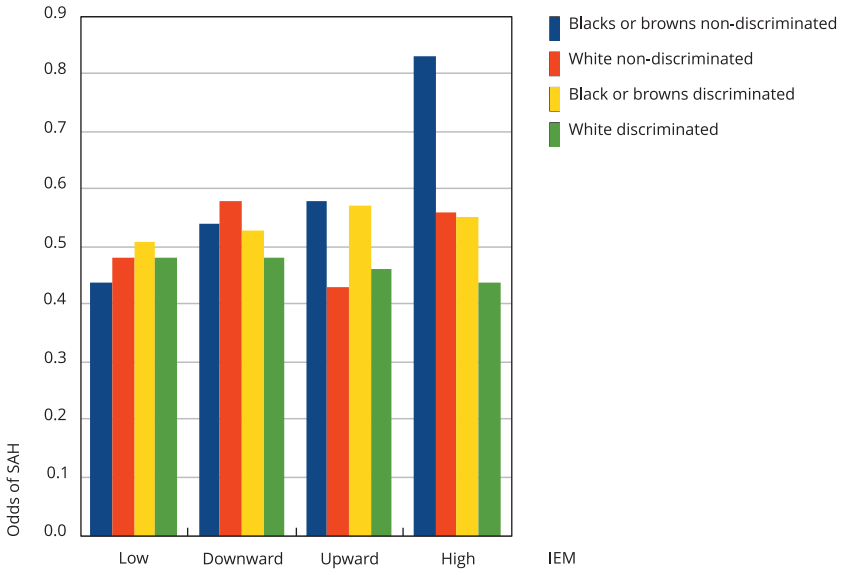
Analyses of interaction between discrimination and maternal intergenerational educational mobility (IEM) and skin color/"race", maternal model.



SAH: systolic arterial hypertension.

Figure 3

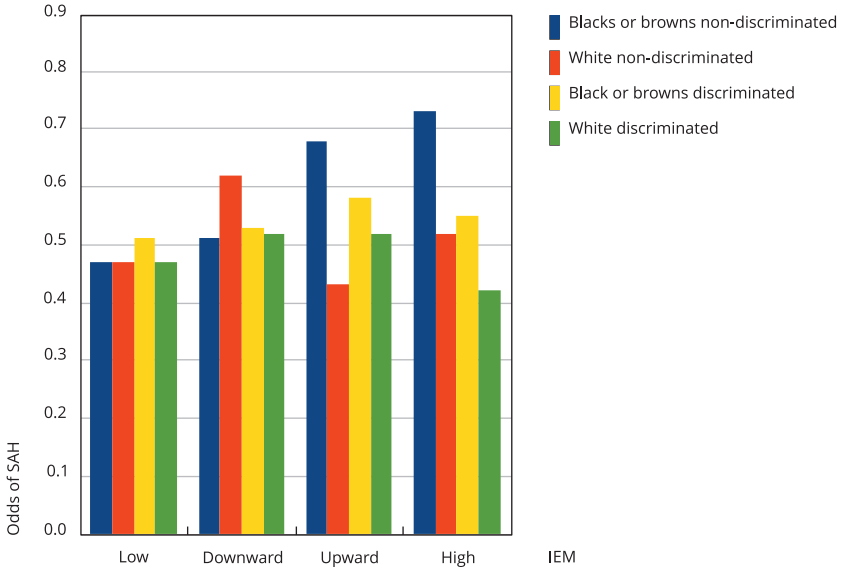
Analyses of interaction between discrimination and paternal intergenerational educational mobility (IEM) and skin color/"race", paternal model.



SAH: systolic arterial hypertension.

Figure 4

Analyses of interaction between discrimination and family intergenerational educational mobility (MEI) and skin color/"race", family model.



SAH: systolic arterial hypertension.

Discussion

The current article analyzed the influence of IEM on the occurrence of SAH in adults in a city in southern Brazil. The results of the multilevel longitudinal analysis with random effects showed that persistence in high socioeconomic status (high IEM) significantly reduced the odds of SAH in all the models. Interaction between interpersonal discrimination and IEM was also tested in an analysis stratified by skin color/"race", showing that the odds of SAH increased in the downward category of IEM among black or brown individuals who reported discrimination, compared to those not reporting it.

The high prevalence of SAH in the current study (44.9%) is close to the prevalence observed by other authors in Latin America and the Caribbean (39.1%, 95%CI: 33.1; 45.2) [25]. However, it exceeds the prevalence rates reported in other Brazilian studies, such as the *National Health Survey* of 2013 (22.9% in the South of Brazil) [26] and the *Vigitel Brazil 2017 Supplementary Health s*urvey (21,5% in Florianópolis, Santa Catarina State) [27]. The difference is that the data from the two latter studies only refer to individuals who reported a medical diagnosis of SAH, while the current study included the use of antihypertensive medication (6% prevalence at baseline) and the mean of two measurements of systolic/diastolic blood pressure, which may have contributed to the higher observed prevalence.

In this study, hypertension was more prevalent in black and brown individuals (51.3%) than in whites (44.1%), corroborating previous studies [6]. In racially unequal countries like Brazil, color/"race" is an indicator of social class and structural racism, besides acting as a target for interpersonal discrimination, affecting health unfavorably [28]. A study in Cuba, a country with less racial inequality than Brazil, found no difference in SAH prevalence between blacks and whites [29].

No relevant differences were observed in the prevalence of SAH between total household income quintiles, between childhood educational levels, or between individuals with or without experiences of discrimination. Although the prevalence of SAH was similar in these groups, studies have been performed to demonstrate that life-course experience with discrimination [6,28], material deprivation since childhood [30], and parents' low schooling [31] can influence blood pressure and health in adulthood. In the study sample, SAH was more prevalent in individuals with low schooling, corroborating observations from previous studies [2,5,6]. Individuals with downward IEM also displayed high prevalence of SAH, followed by those who maintained low educational level throughout life. A longitudinal study of twins in Sweden [32] and a cross-sectional study in the USA with black men [33] found that prevalence of SAH was higher in individuals that remained in low socioeconomic status throughout life.

The fixed effects of the multilevel longitudinal analysis showed that only high IEM was capable of significantly reducing the odds of SAH when compared to individuals with low IEM. This raises concern in Brazil, considering the persistence of schooling levels at the social extremes, hindering changes in participants' socioeconomic status in relation to their parents when childhood socioeconomic status is low [12,13]. In addition, even upward intergenerational schooling in Brazil has not produced the same favorable effect of maintaining high socioeconomic status throughout life. Corroborating the current study's results, despite the methodological and contextual differences, a cross-sectional study in African American adults found an association between constantly high lifetime socioeconomic status and SAH (OR = 7.27, 95%CI: 1.91; 27.51) in comparison to constantly low socioeconomic status [33]. Some authors suggest that schooling can affect health through a system of cumulative disadvantages involving behaviors with an impact on health and prevention and treatment of diseases, as well as through stressful workplaces and the residential neighborhood's socioeconomic context [34,35,36].

In addition, according to the random effects, the ICC of the random intercept (0.91 in the three models) showed that a large share of the outcome's variance in the paternal model (model 1), maternal model (model 2), and family model (model 3) can be explained by the participants' individual characteristics, which are unchangeable throughout the study and are not measured in the tested models. For example, some authors suggest that maternal breastfeeding and birthweight can produce latent effects that have the power to influence blood pressure in adulthood [22,31]. Besides, situations of psychosocial stress such as material deprivation in childhood, adolescence, and youth can act on blood pressure in adulthood [30,37].

The analyses of interaction between interpersonal discrimination and IEM showed a reduction in the odds of SAH in practically all the categories of IEM with reported discrimination and in all the

models. This effect can result from internalized oppression [38], a perspective that affirms that individuals do not always report what they experience, even when somatic manifestations demonstrate the opposite (embodiment). Thus, individuals that did not report discrimination because they did not see themselves as victims of such acts, even though they had been, may have constituted the "non-discriminated" reference category, leading to this contradictory result.

The inconsistency of the results found in the literature relating interpersonal discrimination to SAH may also have been due to non-reporting or non-recognition of certain forms of treatment as discriminatory. The most consistent evidence relates discrimination to outpatient blood pressure, which can be considered an indicator of an immediate reaction to stress, not dependent on the individuals' understanding and reporting of a discriminatory act [28]. Importantly, the reduction in the odds of SAH among individuals that reported discrimination does not mean a beneficial effect of discrimination on blood pressure. Neither does it legitimize social injustice or the acceptance of social inequalities in SAH and in health in a broader sense. However, it highlights the need to understand how discrimination is perceived and reported and how it impacts individuals' health. Besides, the search for solutions to fight discrimination does not depend on the reason that triggers such discrimination and overrides the results of scientific studies.

We also observed differences in the pattern of odds of SAH in the paternal and maternal models among black or brown individuals with low IEM, and among whites in the maternal model with downward IEM, indicating that mobility measured on the basis of the father can have a different effect from mobility measured on the basis of the mother. Brazil has an important share of single-parent families headed by women (16.3%) [39], suggesting a relevant maternal influence on health behaviors and beliefs in adulthood. However, more studies are needed that analyze the problem from this perspective.

Conclusion

The current article's results reinforce the importance of awareness-raising on SAH in adults in southern Brazil from a life-course perspective. The study found that across generations, maintaining the parents' high level of schooling favored the reduction of SAH, although random variables also influenced the increase in blood pressure. Upward IEM did not significantly reduce the effects of unfavorable childhood socioeconomic status. This reiterates the need for long-term public policies aimed at continuing education in the country as well as improvement in the population's health.

The results of the stratified analysis by skin color/"race" suggest that situations of discrimination can act jointly with unfavorable IEM, increasing the odds of SAH, especially among black and brown individuals. This result provides even more backing for the argument that hypertension and its social inequalities should be confronted with public policies prioritizing education, which have not only a direct effect on the problem, but also an indirect effect, reducing the manifestations of discrimination.

Contributors

W. Nishida contributed in the conceptualization and elaboration of the manuscript, data analysis and interpretation, critical revision of the content, and approval of the final version for publication. E. Kupek and C. Zanelatto contributed in the data analysis and interpretation, critical revision of the content, and approval of the final version for publication. J. L. Bastos contributed in the conceptualization and elaboration of the manuscript, coordination and supervision of research, analysis and interpretation of data, critical revision of the content, and approval of the final version for publication.

Additional informations

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Resumo

A hipertensão arterial sistêmica (HAS) é um relevante problema de saúde pública mundial, marcado por desigualdades sociais. No Brasil, estudos sobre a HAS adotando uma perspectiva teórica de curso de vida são escassos. O presente artigo visa a analisar a relação entre mobilidade educacional intergeracional (MEI) e HAS em adultos brasileiros, verificando o impacto da discriminação interpessoal e da cor/"raça" nesta relação. Foram analisados dados dos pais e de 1.720 adultos, entre 20 e 59 anos, do Estudo EpiFloripa Adulto. Modelos de regressão multinível com efeitos aleatórios foram estimados. Os efeitos fixos mostraram relação inversa entre MEI e odds *de HAS, com significância estatística para MEI alta (modelo paterno: OR [*odds ratio*] = 0,39, p = 0,006; modelo materno: OR = 0,35, p = 0,002; e modelo familiar: OR = 0,35, p = 0,001). Análises de interação demonstraram, por sua vez, que situações de discriminação podem atuar conjuntamente com a MEI desfavorável, elevando a* odds *de HAS, especialmente entre negros e pardos. Conclui-se que a MEI constantemente alta é capaz de reduzir significativamente a odds de HAS, mas que a discriminação pode intensificar o efeito de baixos níveis de educação, especialmente em segmentos da população socialmente marginalizados.*

Iniquidade Social; Doenças Cardiovasculares; Racismo; Mobilidade Social; Análise Multinível

Resumen

La hipertensión arterial sistémica (HAS) es un problema relevante de salud pública mundial, marcado por desigualdades sociales. En Brasil, los estudios sobre la HAS, adoptando una perspectiva teórica de curso de vida, son escasos. El objetivo de este artículo es analizar la relación entre movilidad educacional intergeneracional (MEI) y HAS en adultos brasileños, verificando el impacto de la discriminación interpersonal y del color/"raza" en esa relación. Se analizaron datos de los padres y de 1.720 adultos, entre 20 y 59 años, del Estudio EpiFloripa Adulto. Se estimaron modelos de regresión multinivel con efectos aleatorios. Los efectos fijos mostraron una relación inversa entre MEI y odds *de HAS, con significancia estadística para MEI alta (modelo paterno: OR [*odds ratio*] = 0,39, p = 0,006; modelo materno: OR = 0,35, p = 0,002; y modelo familiar: OR = 0,35, p = 0,001). Los análisis de interacción demostraron, a su vez, que situaciones de discriminación pueden actuar conjuntamente con la MEI desfavorable, elevando la* odds *de HAS, especialmente entre negros y mulatos/mestizos. Se concluye que una MEI constantemente alta es capaz de reducir significativamente la odds de HAS, sin embargo, la discriminación puede intensificar el efecto de bajos niveles de educación, especialmente en segmentos de la población socialmente marginados.*

Inequidad Social; Enfermedades Cardiovasculares; Racismo; Movilidad Social; Análisis Multinivel

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