Policies for expanding access to higher education and changing the profile of medical graduates in Brazil: a cross-sectional study

Alexandre Medeiros de Figueiredo (https://orcid.org/0000-0003-1433-088X) [1,2]
Kenio Costa de Lima (https://orcid.org/0000-0002-5668-4398) [2]
Adriano Massuda (https://orcid.org/0000-0002-3928-136X) [3]
George Dantas de Azevedo (https://orcid.org/0000-0002-7447-7712) [4]

[1] Departamento de Promoção da Saúde, Universidade Federal da Paraíba. Campus I, Jardim Universitário s/n, Castelo Branco. 58051-900 João Pessoa PB Brasil. potiguar77@gmail.com
[2] Universidade Federal do Rio Grande do Norte (UFRN). Natal RN Brasil.
[3] Escola de Administração de Empresas de São Paulo, Fundação Getúlio Vargas. São Paulo SP Brasil.
[4] Escola Multicampi de Ciências Médicas, UFRN. Natal RN Brasil.

Abstract *This study assesses the effectiveness of policies to expand access to higher education in reducing inequities in the profile of graduates from medical courses in Brazil. This work consists of a cross-sectional study using data from the 2018 Higher Education Census. Analyses were carried out to identify the association between being a beneficiary of the Quota Law, the University for All Program, or the Student Financing Fund and three markers: born in a small-sized municipality, being non-white, or having attended high school in a public school. Analyses were performed using Pearson's chi-square test, and multivariate analysis was conducted using Poisson regression. A significant association was found between being a beneficiary of these policies and being a non-white graduate, who was born in a small town and who had studied in a public high school. All policies presented adjusted Prevalence Ratio (PR), which demonstrated an association with statistical significance. The Quota Law was the most effective policy, with RP=1.92 for non-white graduates, RP=6.66 for having studied in a public high school, and RP=1.08 for being born in a small town. Despite these results, these groups remain underrepresented in medical courses and in the workforce.*
Key words *Workforce, Medical Education, Public Policy, Socioeconomic factors, Social Segregation*

Introduction

Access to medical schools is strongly influenced by socioeconomic and cultural factors, which determine the characteristics of the medical workforce[1]. Studies have demonstrated that, even in developed countries, such as the United Kingdom[1,2], the United States[3], and Canada[4], graduates who are from minority ethnic groups or from disadvantaged socioeconomic classes are underrepresented in medical schools.

Brazil is one of the most unequal countries in the world. In 2019, the Gini index for per capita home income was 0.543[5]. In the same year, half the Brazilian population earned only 15.6% of the nation's income, while the richest 10% concentrated 42.9% of the entire country's income[5]. The average per capita home income of the black population was approximately half of what was earned by the white population, which demonstrates historical racial and structural inequalities in the Brazilian population[5].

In the field of health, inequalities can be seen in the underprivileged population's limited access to health services[6,7], as well as in a poorer ratio of doctors by population in poorer towns[7]. These differences in accessibility to health services contribute to higher rates of morbidity and mortality in the black[8-11] and poorest populations[12], as became evident during the COVID-19 epidemic[8,10,13,14].

Inequalities are also present in the access to higher education[15,16]. Students who attend private high schools have twice as many chances to be accepted to college, in comparison to students from public schools[15]. The percentage of white students who finished high school and entered college was 51.5%, in comparison to 33.4% of black students[15].

The impact of the Brazilian socioeconomic disparities in education was even higher in terms of access to medical schools. A nationwide study based on data from the ENADE 2004 socioeconomic questionnaire found that 67% of the students in the last year of medical school were from families with a family income above 10 minimum wage salaries, 79.4% were white, and only 9% graduated from public high schools[16]. Data from a 2014-2015 survey identified that 77.20% of the graduates from medical schools were white[17].

The literature describes some initiatives for expanding the access to medical schools to less privileged groups, such as the creation of admission programs, the priority selection of students from poorer areas, student loans, and scholar-

ships for socially vulnerable segments of the population[1,2,18-21]. These actions have two main objectives: 1) to expand the access of students from poorer classes to medical schools[3,19,22] and 2) to expand the access and the quality of care provided to minority group populations or those who live in vulnerable areas[3,19,22,23]. The second objective is based on the findings from studies which indicate that doctors from minority groups are more likely to work in areas where medical professionals are scarce, thus reducing inequalities in access to health care[3,19,22,23].

Furthermore, studies suggest that the ethnic-racial concordance between doctor and patient results in better communication, more trust, and patient satisfaction[3,22]. A recent study conducted in the United States demonstrated that mortality among newborn black children was lower when they were cared for by black doctors[23]. Another American study showed that students from schools with a more ethnically diverse students claim that they are better prepared to work in areas with racial minorities or with a poorer population[24].

Since 2003, several programs have been implanted to create more availability and reduce the inequalities in access to higher education in Brazil[16]. There has been an increase in the number of available places at federal universities, guaranteed by the Program to Support the Plan for Restructuring and Expansion of Federal Universities (REUNI, in Portuguese), and financing policies to improve access of students to private universities[16]. Among those initiatives, we can highlight the University for All Program (PROUNI, in Portuguese - 2005) which offers scholarships in private universities for students from low income families, and the Student Financing Fund (FIES, in Portuguese - 2001/2010), which provided loans for financing the cost of college education in private universities[16].

The number of places available in medical schools in Brazil has expanded exponentially in recent years, mostly due to the opening of new private universities[7]. In 2018, there were 35,755 places in medical schools, 25,173 (74.4%) of which were in private schools[7]. At the same time, there was the gradual implementation of affirmative actions (quotas for races and social groups) in public universities, intensified after the creation of Law 12,711/2012[25], which defined that within four years (2016), 50% of the places available in federal universities should be offered to public high school graduates, additionally considering the criteria of low family income

and race/color[16,25]. All of these policies are based on criteria that prioritize the access to medical schools for underprivileged individuals; however, only part of the medical school graduates are benefited by these policies.

Evaluating public policies is something relevant, it generates knowledge to allow for better decisions by public agents. It also subsidizes the public debate by society and increases the efficiency of government actions[26]. The process of evaluating public policies may focus on different aspects, such as: the analysis of the policies' design, the implementation process, and the results achieved[26]. In this perspective, the current study evaluated the effects of the expansion policies of access to higher education on the profile of the graduates from medical schools in Brazil, aiming to evaluate its impact on the reduction of social and racial inequalities in the makeup of the medical profession.

Methodology

This is a cross-sectional study that analyses data of graduates from Medical courses, available in the databank of the Higher Education Survey by the National Institute of Educational Studies and Research (INEP, in Portuguese)[27]. Data from the 2018 graduates were analyzed, since this was the first graduating class after the implementation of the quota law[25]. The data was extracted using the *dplyr* package of the R-3.6.1.

The following variables concerning the receiving of loans from FIES, receiving of scholarships from PROUNI (partial or full), admission in college through the system of quotas, administrative category of the medical school where the students graduated from (public or private), sex, and age of the graduates at the conclusion of the course (above or below the average) were analyzed as explanatory variables. The associations between these variables and the characteristics of the graduates were also analyzed: being from a town with less than 20,000 inhabitants in 2010, non-white race/color, and having concluded public high school. These variables were used as proxies to identify changes in the profile of the graduates which could be considered a reduction in social and racial inequalities.

The race/color variable was used to evaluate the increase in racial and ethnic diversity in medical schools, categorized as "white" or "non-white" (black, brown, yellow, or indigenous). Having completed public high school was a marker of

economic condition, and the town of origin was a variable used to identify the changes in access to education by students from small towns, which are the locations with a greater scarcity of doctors in the country[28].

A descriptive analysis was conducted considering the entire database categorized by the administrative category of the higher education institution from which the individuals graduated. Next, bivariate analyses were conducted using the Pearson chi-square test for each of the three variables defined as proxies of reduction of inequality in access to medical schools. For each analysis, the dependent variable was categorized in a dichotomous manner, excluding the graduates with missing data. Analyses were also conducted to compare the presence of differences in the percentage of missing data in each analysis, seeking to identify losses which could not be considered random. All the explanatory variables were considered for the multivariate Poison regression analysis, with a robust estimation for better adjustment in the case of events with great prevalence. The objective of this evaluation was to check the effect, regardless of each of the measures applied to expand access to higher education, on the independent variables, calculating both the Prevalence Ratio (PR) and its respective 95% confidence intervals (95%CI). The statistical analyses were performed using the SPSS package (IBM SPSS Statistics for Windows V.20).

Results

The profile of the graduates (Table 1) indicates a predominance of the female sex, age equal or below 26, born in towns with more than 20,000 inhabitants, and predominantly white. The percentage of female graduates and of individuals over 27 years of age was higher in the private schools. White students made up71.25% of the graduates from medical schools in Brazil, and the percentage of graduates from private medical schools (75.51%) was higher than the percentage found for public schools (64.04%). There was a higher percentage of students who graduated from public high schools among the graduates from public medical school (27.78%).

FIES was the program with the most beneficiaries, used by 30.57% of the graduates, benefiting almost half of the students who went to private medical colleges. The percentage was only 1.31% of the graduates from public high schools, almost all of whom were connected to munici-

pal institutions. Those institutions, although linked to the government, require the payment of monthly fees from the students. Most of the graduates who made use of FIES were people who referred to themselves as white (72.01%).

The PROUNI beneficiaries (partially and fully) were only 5.49% of the graduates from private schools, a much lower percentage than that found for FIES beneficiaries. The majority of the graduates who used the PROUNI were white (53.79%).

Among the graduates, 5.94% were admitted through the quota system, 98.34% of whom studied in public colleges. The percentages of graduates admitted through the quota system were 16.77% for state schools and 15.95% for federal schools. It is important to highlight that not a single graduate from a public municipal

school benefited from affirmative action policies. The students admitted to colleges through the quota system were mostly "non-white" (64.25%).

The number of graduates, included in the analyses conducted to evaluate the impact of the policies, varied due to the amount of missing data. The losses were 20.2% for analyses related to race/color, 19.2% for analyses related to the graduates' place of origin, and 3.9% related to the kind of high school from which the students graduated. The detailed analysis of losses is available in the Table 2.

The analysis of the distribution of graduates by race/color demonstrates that the percentage of "non-white" graduates is higher among men, and among the graduates over 26 years of age. The percentage of "non-white" graduates was higher among the graduates from public universities,

Table 1. Characteristics of medical school graduates in 2018 by the administrative category of the medical school, Brazil.

Characteristics of graduates	Public Universities		Private Universities		Total	
	n	%	n	%	n	%
Sex						
Male	3553	48.38	4630	38.94	8183	42.54
Female	3791	51.62	7260	61.06	11051	57.46
Age range						
Aged 26 years or under	4686	63.81	7231	60.82	11917	61.96
Aged 27 years or over	2658	36.19	4659	39.18	7317	38.04
Entered through Quota System						
No	6220	84.69	11871	99.84	18091	94.06
Yes	1124	15.31	19	0.16	1143	5.94
FIES user						
No	7248	98.69	6107	51.36	13355	69.43
Yes	96	1.31	5783	48.64	5879	30.57
PROUNI beneficiary						
No	7344	100.00	11237	94.51	18,581	96.60
Yes	0	0.00	653	5.49	6.53	3.40
Type of high school						
Private	4853	66.08	9016	75.83	13869	72.11
Public	2040	27.78	2570	21.61	4610	23.97
No information	451	6.14	304	2.56	755	3.93
Race/color						
White	3648	49.67	7287	61.29	10935	56.85
Non-White	2048	27.89	2364	19.88	4412	22.94
No information	1648	22.44	2239	18.83	3887	20.21
Born in a town with less than 20,000 inhabitants						
No	4677	63.68	9822	82.61	14499	75.38
Yes	307	4.18	731	6.15	1038	5.40
No information	2360	32.14	1337	11.24	3697	19.22

Source: Authors.

among students admitted through the quota system, and among participants of PROUNI. The same pattern did not occur among beneficiaries of FIES (Table 3).

A little less than one fourth of the medical school graduates (24.9%) concluded high school in a public school (Table 4). The percentage of graduates who concluded public high school was significantly higher among the male graduates, among the older students, among the beneficiaries of all the measures applied to improve access to universities, and among the graduates from public medical schools.

There was a higher percentage of graduates among individuals from towns with less than 20,000 inhabitants, among the graduates over 26 years of age and among the beneficiaries of FIES, PROUNI, and the quota system (Table 5).

The multivariate analysis demonstrates that the quota system was the policy which most influenced access to medical schools for "non-white" students (PR=1.92; 95%CI=1.76-2.10; p<0.01), to students who went to public High Schools (PR=6.66; 95%CI=5.68-7.80; p<0.01) and to the ones who were from towns with less than 20,000 inhabitants (PR=1.08; 95%CI=1.05-1.11; p<0.01) (Table 6). PROUNI was also associated with an increase in the chances of a graduate from medical schools being non-white (PR=1.46; 95%CI=1.35-1.58; p<0.01), having concluded public high school (PR=1.83; 95%CI=1.67-2.01; p<0.01), and being from a town with less than 20,000 inhabitants (PR=1.04; 95%CI=1.01-1.07; p<0.05). FIES, by contrast, was associated with a higher probability of the graduate being non-white (PR=1.11; 95%CI=1.08-1.13; p<0.01), having graduated from a public high school (PR=1.02 95%CI=1.00-1.04; p<0.01), and being from a town with less than 20,000 inhabitants (PR=1.03; 95%CI=1.02-1.04; p<0.01).

Another relevant finding was the higher probability of a graduate being of a "non-white" race/color among the graduates from public universities (PR=1.16; 95%CI=1.13-1.19; p<0.01).

Discussion

In Brazil, the Quota Law, PROUNI, and financing through FIES are associated with the increase in diversity in medical schools – racial, social, and including more people from towns with less

Table 2. Analyses related to the missing data.

Characteristics of graduates	Missing data					
	Race/color		Type of high school		Place of birth	
	n (%)	p-value	n (%)	p-value	n (%)	p-value
Sex						
Male	1657 (20.2)	>0.05	361 (4.4)	<0.05	1665 (20.3)	<0.01
Female	2230 (20.2)		394 (3.6)		2032 (18.4)	
Age						
Up to 26 years	2237 (18.8)	<0.01	376 (3.2)	<0.01	2297 (19.3)	>0.05
27 years or over	1650 (22.6)		379 (5.2)		1400 (19.1)	
Administrative category						
Private	2239 (18.8)	<0.01	451 (6.1)	<0.01	1337 (32.1)	<0.01
Public	1648 (22.4)		304 (2.6)		2360 (11.2)	
Entered through Quota System						
No	3695 (20.4)	<0.01	741 (4.1)	<0.01	3358 (18.6)	<0.01
Yes	192 (16.8)		14 (1.2)		339 (29.7)	
FIES user						
No	2567 (19.2)	<0.01	561 (4.2)	<0.05	3022 (22.6)	<0.01
Yes	1320 (22.5)		194 (3.3)		675 (11.5)	
PROUNI beneficiary						
No	3762 (20.2)	<0.05	732 (3.9)	>0.05	3630 (19.5)	<0.01
Yes	125 (19.1)		23 (3.5)		67 (10.3)	
Total						

Source: Authors.

Table 3. Characteristics of medical school graduates in 2018 by race/color.

Characteristics of graduates	Race/color				p-value
	White		Non-White		
	n	(%)	n	(%)	
Sex					
Male	4531	69.43	1995	30.57	p<0.001
Female	6404	72.60	2417	27.40	
Age					
Up to 26 years	7153	73.89	2527	26.11	p<0.001
27 years or over	3782	66.74	1885	33.26	
Administrative catergory of medical school					
Private	7287	75.51	2364	24.49	p<0.001
Public	3648	64.04	2048	35.96	
Entered through Quota System					
No	10595	73.60	3801	26.40	p<0.001
Yes	340	35.75	611	64.25	
FIES beneficiary					
No	7652	70.93	3136	29.07	p>0.05
Yes	3283	72.01	1276	27.99	
PROUNI beneficiary					
No	10651	71.87	4168	28.13	p<0.001
Yes	284	53.79	244	46.21	
Total	10935	**71.25**	4412	28.75	

Source: Authors.

Table 4. Characteristics of medical school graduates in 2018 by type of high school.

Characteristics of graduates	Type of high school				p-value
	Private		Public		
	n	(%)	n	(%)	
Sex					
Male	5751	73.52	2071	26.48	p<0.001
Female	8118	76.18	2539	23.82	
Age					
Up to 26 years	9052	78.43	2489	21.57	p<0.001
27 years or over	4817	69.43	2121	30.57	
Administrative category of medical school					
Private	9016	77.82	2570	22.18	p<0.001
Public	4853	70.40	2040	29.60	
Entered through Quota System					
No	13733	79.15	3617	20.85	p<0.001
Yes	136	12.05	993	87.95	
FIES beneficiary					
No	9422	73.64	3372	26.36	p<0.001
Yes	4447	78.22	1238	21.78	
PROUNI beneficiary					
No	13599	76.19	4250	23.81	p<0.001
Yes	270	42.86	360	57.14	
Total	13869	75.05	4610	24.95	

Source: Authors.

Table 5. Characteristics of medical school graduates in 2018 by population size of the place of birth.

| Characteristics of graduates | Population size of the place of birth | | | | p-value |
| | More than 20,000 inhabitants | | Up to 20,000 inhabitants | | |
	n	(%)	n	(%)	
Sex					
Male	6,057	92.93	461	7.07	p >0.05
Female	8,442	93.60	577	6.40	
Age					
Up to 26 years	9,019	93.80	601	6.20	p < 0.01
27 years or over	5,480	92.60	437	7.40	
Administrative category of medical school					
Private	9,822	93.07	731	6.93	p >0.05
Public	4,677	93.84	307	6.16	
Entered through Quota System					
No	13,794	93.63	939	6.37	p<0.001
Yes	705	87.69	99	12.31	
FIES beneficiary					
No	9,718	94.05	615	5.95	p<0.001
Yes	4,781	91.87	423	8.13	
PROUNI beneficiary					
No	13,968	93.43	983	6.57	p < 0.01
Yes	531	90.61	55	9.39	
Total	14,499	93.32	1,038	6.68	

Source: Authors.

Table 6. Prevalence ratio (adjusted) of the characteristics of the graduates associated with non-white race/color, schooling in public high school, and place of birth with less than 20,000 inhabitants.

| Characteristics of graduates | Non-white graduates | | Graduates who studied in a public high school | | Graduates born in a town with less than 20,000 inhabitants | |
	PR (95% CI)	p-value	PR (95% CI)	p-value	PR (95% CI)	p-value
Age ≥ 27 years	1.10 (1.07-1.12)	p < 0.01	1.11 (1.09-1.13)	p < 0.01	1.01 (1.00-1.02)	p < 0.05
Male	1.03 (1.01-1.05)	p < 0.05	1.02 (1.00-1.03)	p < 0.05	1.01 (0.99-1.02)	p > 0.05
Entered through Quota System	1.92 (1.76-2.10)	p < 0.01	6.66 (5.68-7.80)	p < 0.01	1.08 (1.05-1.11)	p < 0.01
PROUNI beneficiary	1.46 (1.35-1.58)	p < 0.01	1.83 (1.67-2.01)	p < 0.01	1.04 (1.01-1.07)	p < 0.05
FIES user	1.11 (1.08-1.13)	p < 0.01	1.02 (1.00-1.04)	p <0.05	1.03 (1.02-1.04)	p < 0.01
Graduate from public university	1.16 (1.13-1.19)	p < 0.01	0.99 (0.97-1.01)	p > 0.05	0.99 (0.98-1.00)	p > 0.05

Source: Authors.

than 20,000 inhabitants. The Quota Law and PROUNI were the most efficient interventions to reduce social and racial inequalities. Those measures, although more efficient than FIES, are not as far reaching, benefiting together 9.3% of the graduates, whereas FIES benefited almost a third of the graduates from medical schools in 2018.

The predominance of female graduates indicates a tendency of the feminization of the medical workforce, a phenomenon which has been evident in Brazil in recent decades[17,29]. Currently, although the majority of the doctors in Brazil are still men, women are the majority among the professionals under 34 years of age[17].

The percentage of graduates who studied in public high schools (24.9%) in 2018 was nearly three times higher than the percentage found in a 2004 study (9%)[16]. These results are in agreement with other Brazilian studies, which analyzed changes in the profile of the faculties of public universities and indicate that there has been an increase in the number of students from lower income families[30-33]. Regardless of these progresses, there is still an underrepresentation of graduates from public high schools in medical schools. This finding is corroborated by the current study, in which nearly one fourth of the medical school graduates in 2018 graduated from public high schools. By contrast, students from public schools account for two thirds of all high schools graduates in Brazil[15].

In Brazil, there are few studies analyzing the profile of the students of medical schools according to race/color. In 1997, one study, which analyzed the profile of the students from the Medical School of the Federal University of Espírito Santo found that 68.6% of the students were white[34]. Recently, other studies have been conducted in public universities, both state and federal, where affirmative action measures have been implemented[30-33]. The percentage of students who were "non-white" in those studies ranged from 22.5% in the Medical Sciences College of the State University of Campinas[31] to 68% in the Federal University of Bahia[33]. Such a variation may be related to the process through which affirmative action was implemented and to differences in the ethnic makeup of the regions where the schools are located. Studies which evaluated the variable race/color among students who entered State medical schools in the cities of Campinas[31] and Rio de Janeiro[32], over a several-year period, indicate that there has been an increase in the ratio of "non-white' students in more recent years, indicating a discrete increase in racial diversity in medical schools.

The data from this study shows a small drop in "white" graduates when comparing data from the research conducted in 2004 (79.4%)[16] and in 2014-2015 (77.20%)[4] with the results found in 2018 (71.25%). The percentage of "non-white" graduates (28.75%) is still greatly below the percentage of "non-white" people in the general population in 2018 (56.90%)[35].

Among the interventions analyzed in this study, only the admission through a quota system has benefited a majority of non-white graduates. However, the impact of the different quota systems may have heterogeneous results. A study by the State University of Rio de Janeiro conducted an analysis to identify the racial characteristics of the students according to different admission methods. The percentage of "white" students who were admitted to the medical school through open competition was 82%[32]. Among students who were admitted by the system of places reserved for graduates from public high schools and students who were admitted by the system based on family income, the percentage of white students was, respectively, 76% and 71%[32]. The brown students were the majority (77%) only in the method exclusively based on racial quotas[32]. Such a difficulty in reducing inequalities in access to medical schools indicate the need to analyze the several systems of affirmative action in Brazil, since it is possible that affirmative actions based strictly on social criteria are insufficient to reverse the inequalities among the medical workforce. Another relevant aspect is that the percentage of graduates in federal universities in 2018 was about 16%, which indicates the level of implementation of the Quotas Law shortly after its publication, and the challenge of increasing that percentage in the following years.

Only 5.4% of the medical school graduates had been from towns with less than 20,000 inhabitants, while the percentage of Brazilians who lived in towns of that population cohort was 15.4% in 2018[36]. Therefore, the results of this study indicate that there is an underrepresentation of students from small towns in medical schools, which points to another dimension of the inequalities in access to medical schools. The increase in the number of places, which has intensified in recent years, has reduced the inequalities among the macro-regions of the country[7,37]; however, due to issues of infrastructure in the network of services, the majority of the places available for medical students was located in towns with more than 50,000 inhabitants[37]. Therefore, the creation of more places in medical schools in small towns, as an isolated strategy, is insufficient and must be accompanied by other measures.

In Brazil, small towns have a scarcity of doctors, with a ratio of 0.63 doctors for every 1,000 inhabitants – this rate is almost 5-fold smaller than that found for towns with more than 500,000 inhabitants[7]. Studies have demonstrated that the fact of having been born in rural areas or small municipalities increases the probability that the doctor ends up working in similar places during their professional life[38-41]. Besides the inequalities in access to medical schools, the small percentage of graduates from small towns may function as a

limiting factor in the capability of reducing the scarcity of doctors in places other than large urban areas. Therefore, the implementation of affirmative action measures to guarantee a higher number of students from small towns in medical schools may help reduce inequalities in access to both higher education and medical assistance. It should be emphasized that the PR values for the marker "being from a small town", found for the Quotas Law and PROUNI, were well below what was found for the markers that evaluated changes in racial composition and the inclusion of students from public high schools, revealing that those measures produced a minimal effect in reducing regional inequalities.

In other countries, there are policies for specifically selecting students from remote regions[30]. One strategy used worldwide is to financially subsidize the education of students from regions with a scarcity of doctors, with those subsidies conditioned to the return to work in remote areas[38,40,41]. In Brazil, some affirmative actions were implemented, which contemplated the selection of medical students who were from small towns in the regions near towns where medical schools were created[42]. However, the impact of those actions is recent and restricted to only a few colleges, limiting the reduction of inequalities as mentioned in this study. Therefore, we suggest implementing affirmative actions that are more encompassing and include selection criteria that can increase the number of students from public high schools and from small towns, especially in regions where there are not sufficient doctors and that are less developed economically.

The analyses were conducted from secondary data from the 2018 Education Census (*Censo de Educação*) and refer to the graduates who entered medical schools in the previous six years. Therefore, the results of this study describe the effects of the implementation of the described measures in 2012 and 2013. Hence, they do not reflect the impact of variations in the number of graduates who were admitted by the quota system, by PROUNI grants, by loans from FIES in the subsequent years and the effect of the expansion of the number of places in colleges as a result of the More Doctors for Brazil Program (PMMB, in Portuguese).

Another limitation of this study was information left blank regarding some variables, with the greatest losses related to the variables of race/color and place of origin. The losses related to information about race/color can be partially explained by the possibility of the graduates having

chosen not to declare their race. However, studies which analyzed other information systems in Brazil also indicate a high rate of undeclared responses for the variable race/color, which suggests that it is difficult to approach racial questions in Brazil[43]. Therefore, it is important that actions are taken by schools to qualify the registry and the planning of actions aimed at reversing the racial inequalities by means of affirmative action initiatives that guarantee opportunities of admission to medical schools and allow medical students to conclude the course.

In the case of the data about the place of origin, it is likely that this information is not highly valued when filling in the education census, in particular due to the lack of a strategy to reverse regional inequalities in terms of the distribution of doctors. There has been a significant difference between the percentage of missing data between private and public universities, which was higher in public institutions. The percentages of missing data about the variable race/color and the variable "type of high school where the graduate studied" were lower for the groups who were admitted through the quota system, most likely because the information is required by federal law. The same is true for the percentage of missing data about the variable race/color for the group benefited by PROUNI scholarships.

Our results indicate positive impacts of the policies adopted in Brazil and some limitations in terms of reversing the identified inequalities, especially racial inequalities. Between the beginning of 2010 and the end of 2018, 19,519 new places were created in medical schools, mostly in private institutions[7]. In the 2016-2018 triennium alone, 10,002 new places were created in private institutions. Therefore, in 2018, 70.4% of the places in medical schools were offered by private schools, and 18.6 by public federal universities[7].

This larger number of places in private medical schools is a limiting factor for the reduction of inequalities, since regardless of the improvements created by programs such as FIES, the high investment required to keep up with the universities' fees or with the loan installments reduce the possibility that people from lower income families have access to medical schools[44]. Such a situation becomes even worse because medical school courses are full time, with a heavy weekly workload, making it very difficult to conciliate studies with paid activities[30-33]. FIES has benefited mostly white students; therefore, in its current format, it does not function as a reducer of racial inequalities.

Moreover, less than 20% of all available places are offered directly at public federal universities, limiting the impact of interventions such as the Quota Law. Therefore, farther reaching affirmative action initiatives, aimed at public and private institutions, and at federal and state universities are required so as to produce an actual reversion of the inequalities. It is also important to qualify the already existing affirmative action policies in order to make them more efficient in the reversal of inequalities concerning the access of black students to high demand college courses such as the medical course.

The Brazilian experience indicates that nationwide measures to regulate the educational system, and private and public financing are efficient in reducing racial and social inequalities in a short period of time, even in the case of countries with severe inequalities. Further studies to evaluate these programs and policies are warranted, from the perspective of analyzing their impacts on the profile of doctors around the country, as well as to identify the necessary adaptations of those strategies to the ongoing social needs. In addition, we suggest that further analysis be conducted to verify if the changes in the profile of the medical graduates and the reduction in inequalities in access to medical schools translate into an increase in the number of doctors in rural areas or less economically developed regions.

Collaborations

AM Figueiredo participated in the conception of the study, data processing, data interpretation, production and revision of the final text, and approval of the final version of the manuscript. KC Lima participated in the conception of the study, interpretation of data, production and revision of the final text, and approval of the final version of the manuscript. A Massuda participated in data interpretation and production of the text, text revision, and approval of the final version of the manuscript. GD Azevedo participated in the conception of the study, data interpretation, production and revision of the final text, and approval of the final version of the manuscript.

References

1. Mathers J, Sitch A, Marsh JL, Parry J. Widening access to medical education for under-represented socio-economic groups: population based cross sectional analysis of UK data, 2002-6. *BMJ* 2011; 342:d918.

2. Kumwenda B, Cleland J, Greatrix R, MacKenzie RK, Prescott G. Are efforts to attract graduate applicants to UK medical schools effective in increasing the participation of under-represented socioeconomic groups? A national cohort study. *BMJ Open* 2018; 8(2):e018946.

3. Carrasquillo O, Lee-Rey ET. Diversifying the medical classroom: is more evidence needed? *JAMA* 2008; 300(10):1203-1205.

4. Young ME, Razack S, Hanson MD, Slade S, Varpio L, Dore KL, McKnight D. Calling for a broader conceptualization of diversity: surface and deep diversity in four Canadian medical schools. *Acad Med* 2012; 87(11):1501-1510.

5. Instituto Brasileiro de Geografia e Estatística (IBGE). *Síntese de indicadores sociais: uma análise das condições de vida da população brasileira*. Rio de Janeiro: IBGE; 2020.

6. Szwarcwald CL, Souza-Júnior PR, Damacena GN. Socioeconomic inequalities in the use of outpatient services in Brazil according to health care need: evidence from the World Health Survey. *BMC Health Serv Res* 2010; 10:217.

7. Figueiredo AM, McKinley DW, Massuda A, Azevedo GD. Evaluating medical education regulation changes in Brazil: workforce impact. *Hum Resour Health* 2021; 19(1):33.

8. Baqui P, Bica I, Marra V, Ercole A, van der Schaar M. Ethnic and regional variations in hospital mortality from COVID-19 in Brazil: a cross-sectional observational study. *Lancet Glob Health* 2020; 8(8):e1018-e1026.

9. Leal MDC, Gama SGND, Pereira APE, Pacheco VE, Carmo CND, Santos RV. The color of pain: racial iniquities in prenatal care and childbirth in Brazil. *Cad Saude Publica* 2017; 33(Supl. 1):e00078816.

10. Ribeiro KB, Ribeiro AF, Veras MASM, Castro MC. Social inequalities and COVID-19 mortality in the city of São Paulo, Brazil. *Int J Epidemiol* 2021; 50(3):732-742.

11. Hone T, Rasella D, Barreto ML, Majeed A, Millett C. Association between expansion of primary healthcare and racial inequalities in mortality amenable to primary care in Brazil: A national longitudinal analysis. *PLoS Med* 2017; 14(5):e1002306.

12. Mallinson PAC, Luhar S, Williamson E, Barreto ML, Kinra S. Socioeconomic position and cardiovascular mortality in 63 million adults from Brazil. *Heart* 2021; 107(10):822-827.

13. Figueiredo AM, Figueiredo DC, Gomes LB, Massuda A, Gil-García E, Vianna RP, Daponte A. Social determinants of health and COVID-19 infection in Brazil: an analysis of the pandemic. *Rev Bras Enferm* 2020; 73(Supl. 2):e20200673.

14. Rocha R, Atun R, Massuda A, Rache B, Spinola P, Nunes L, Lago M, Castro MC. Effect of socioeconomic inequalities and vulnerabilities on health-system preparedness and response to COVID-19 in Brazil: a comprehensive analysis. *Lancet Glob Health* 2021; 9(6):E782-E792.

15. Instituto Brasileiro de Geografia e Estatística (IBGE). *Síntese de indicadores sociais: uma análise das condições de vida da população brasileira*. Rio de Janeiro: IBGE; 2018.

16. Ristoff D. Democratização do campus Impacto dos programas de inclusão sobre o Perfil da graduação. *Cad GEA* 2016; 9:1-68.

17. Scheffer M. *Demografia Médica no Brasil 2018* [Internet]. São Paulo: FMUSP, CFM, Cremesp; 2018 [acessado 2020 nov 20]. Disponível em: http://jornal.usp.br/wp-content/uploads/DemografiaMedica2018.pdf.

18. Spencer A, Young T, Williams S, Yan D, Horsfall S. Survey on Aboriginal issues within Canadian medical programmes. *Med Educ* 2005; 39(11):1101-1109.

19. Fielding S, Tiffin PA, Greatrix R, Lee AJ, Patterson F, Nicholson S, Cleland J. Do changing medical admissions practices in the UK impact on who is admitted? An interrupted time series analysis. *BMJ Open* 2018; 8(10):e023274.

20. Lupton K, Vercammen-Grandjean C, Forkin J, Wilson E, Grumbach K. Specialty choice and practice location of physician alumni of University of California premedical postbaccalaureate programs. *Acad Med* 2012; 87(1):115-120.

21. Girotti JA, Park YS, Tekian A. Ensuring a fair and equitable selection of students to serve society's health care needs. *Med Educ* 2015; 49(1):84-92.

22. Mensah MO, Sommers BD. The Policy Argument for Healthcare Workforce Diversity. *J Gen Intern Med* 2016; 31(11):1369-1372.

23. Greenwood BN, Hardeman RR, Huang L, Sojourner A. Physician-patient racial concordance and disparities in birthing mortality for newborns. *Proc Natl AcadSci USA* 2020; 117(35):21194-21200.

24. Saha S, Guiton G, Wimmers PF, Wilkerson L. Student body racial and ethnic composition and diversity-related outcomes in US medical schools. *JAMA* 2008; 300(10):1135-1145.

25. Brasil. Lei nº 12.711, de 29 de agosto de 2012. Lei de Cotas: dispõe sobre o ingresso nas universidades federais e nas instituições federais de ensino técnico de nível médio. *Diário Oficial da União*; 2012.

26. HM Treasury. *Magenta Book Central Government guidance on evaluation* [Internet]. 2020 [cited 2022 fev 10]. Available from: https://assets.publishing.service.gov.uk/ government/uploads/system/uploads/attachment_data/file/879438/HMT_Magenta_Book.pdf.

27. Brasil. Ministério da Educação (MEC). Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP). *Censo da Educação Superior 2018* [Internet]. [acessado 2020 jul 10]. Disponível em: http://inep.gov.br/microdados.

28. Girardi SN, Stralen AC, Cella JN, Wan Der Maas L, Carvalho CL, Faria Ede O. Impact of the Mais Médicos (More Doctors) Program in reducing physician shortage in Brazilian Primary Healthcare. *Cien Saude Colet* 2016; 21(9):2675-2684.

29. Machado MH. *Os médicos no Brasil: um retrato da realidade*. Rio de Janeiro: Editora Fiocruz; 1997.

30. Cardoso Filho FAB, Magalhães JF, Silva KML, Pereira ISSD. Perfil do Estudante de Medicina da Universidade do Estado do Rio Grande do Norte (UERN), 2013. *Rev Bras Educ Med* 2015; 39(1):32-40.

31. Silva MLAM, Amaral E, Machado HC, Passeri MRR, Bragança JF. Influência de Políticas de Ação Afirmativa no Perfil Sociodemográfico de Estudantes de Medicina de Universidade Brasileira. *Rev Bras Educ Med* 2018; 42(3):36-48.

32. Souza PGA, Pôrto ACCA, Souza A, Silva Junior AG, Borges FT. Perfil Socioeconômico e Racial de Estudantes de Medicina em uma Universidade Pública do Rio de Janeiro. *Rev Bras Educ Med* 2020; 44(3):e090.

33. Veras RM, Fernandez CC, Feitosa CCM, Fernandes S. Perfil Socioeconômico e Expectativa de Carreira dos Estudantes de Medicina da Universidade Federal da Bahia. *Rev Bras Educ Med* 2020; 44(2):e056.

34. Fiorotti KP, Rossoni RR, Miranda AE. Perfil do Estudante de Medicina da Universidade Federal do Espírito Santo, 2007.*Rev Bras Educ Med* 2010; 34(3):355-362.

35. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa Nacional por Amostra de Domicílios Contínua. Características gerais dos domicílios e dos moradores: 2018*. Rio de Janeiro: IBGE; 2019.

36. Brasil. Ministério da Saúde (MS). DATASUS. *População Residente. Censo Instituto Brasileiro de Geografia e Estatística* [Internet]. [acessado 2020 jul 7]. Disponível em: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?ibge/cnv/popbr.def.

37. Figueiredo AM, McKinley DW, Lima KC, Azeyedo GD. Medical school expansion policies: educational access and physician distribution. *Med Educ* 2019; 53(11):1121-1131.

38. Matsumoto M, Inoue K, Kajii E. Policy implications of a financial incentive programme to retain a physicianworkforce in underserved Japanese rural areas. *Soc Sci Med* 2010; 71(4):667-671.

39. Shelker W, Zaharic T, Sijnja B, Glue P. Influence of rural background and rural medical training onpostgraduate medical training andlocation in New Zealand. *N Z Med J* 2014; 127(1403):12-16.

40. Techakehakij W, Arora R. Rural retention of new medical graduates from the Collaborative Project to Increase Production of Rural Doctors (CPIRD): a 12-year retrospective study. *Health Policy Plan* 2017; 32(6):809-815.

41. World Health Organization (WHO). *Increasing access to health workers in remote and rural areas through improved retention: global policy recommendations*. Geneva: WHO; 2010.

42. Melo LP, Santos M, Câmara RBG, Braga LP, Oliveira ALO, Pinto TR, Costa PM, Azevedo GD. A Escola Multicampi de Ciências Médicas da Universidade Federal do Rio Grande do Norte, Brasil, no contexto do Programa Mais Médicos: desafios e potencialidades. Interface (Botucatu) 2017; 21(Supl. 1):1333-1343.

43. Braz RM, Oliveira PTR, Reis AT, Machado NMS. Avaliação da completude da variável raça/cor nos sistemas nacionais de informação em saúde para aferição da equidade étnico-racial em indicadores usados pelo Índice de Desempenho do Sistema Único de Saúde. *Saude Debate* 2013; 37(99):554-562.

44. Scheffer MC, Dal Poz MR. The privatization of medical education in Brazil: trends and challenges. *Hum Resour Health* 2015; 13:96.