

Educational equity and social vulnerability in the territories: cases of Ceará State municipal networks in Fortaleza*¹

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Abstract

The present article is an analysis about the association between educational equity in municipal public primary schools, herein called PS, in Ceará State and in Fortaleza City (more than 70% of school enrollments), and social vulnerability in their territories, between 2011 and 2017. The Social Vulnerability Index (SVI) by Instituto de Pesquisa Econômica Aplicada (IPEA) [Applied Economics Research institute] was used in the study and schools were georeferenced. The concept of equity based on the poverty index model proposed by Foster, Greer and Thorbecke (1984) was operationalized in light of Crahay (2000) and Ribeiro (2014). Social markers, such as race/skin color, gender and economic class, were defined according to 'Critério Brasil' [Brazil Criterion]. All of them took into account students' answers in questionnaires associated with 'Prova Brasil' [Brazil Test], and it allowed widening the sight over equity. It was possible concluding that equity was broadened in Ceará State, and that it has benefited social vulnerability zones in the territories, in a more remarkable way than in the Northeastern region and in Brazil. This trend also benefited traditionally disfavored social groups when social, gender and race/skin color markers were taken into account. Fortaleza shows signs of improved equity in high and low social vulnerability territories in comparison to the other Northeastern capitals.

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Keywords

Ceará – Equity – Educational inequality – Public policy implementation – Educational policies – Social Vulnerability in the territory.

Introduction

The present article is an analysis about the association between educational equity in municipal public primary schools, also known as PS, in Ceará State and in Fortaleza City (more than 70% of school enrollments in the State), and social vulnerability in their territories⁵. This time cut is justified by Ceará's educational performance at this schooling stage, when it comes to access to, permanence in and learning at school - municipal administrations are accountable for almost all school enrollments in the region (CRUZ; FARAH; RIBEIRO, 2020). Mamede *et al.* (2021) state that the Basic Education Development Index, also known as IDEB, recorded for Ceará State's PS has been continuously improving since 2007; it reached a rate higher than that recorded for the country in 2019 and close to that observed for private schools. These results do not meet the greater poverty context observed in other Brazilian states, as stated by Cruz, Farah and Ribeiro (2020), who have pointed out that these results are observed after '*Programa de Aprendizagem na Idade Certa (PAIC)*' [Learning at the Right Age Program] was implemented. Codes *et al.* (2018) stress that this program was implemented within a low financing-capacity context, in a state that depends on the Federal Government to complete its resources, based on the Fund for Maintenance and Development of Basic Education and for the Valorization of Education Professionals, also known as FUNDEB. This scenario shows the relevance of improving educational indices. Cruz, Ribeiro and Batista (2022) shine light on the presence of macro-level implemented rules and on agents that added to FUNDEB resources. Political and institutional aspects were favorable to PAIC, including the collaboration regime between municipalities and the State. Yet, it regards a context where research has evidenced equity broadening (PADILHA *et al.*, 2013) partly due to PAIC (KASMIRSKI; GUSMAO; RIBEIRO, 2017). Leandro Costa and Martin Carnoy (2015) have noticed that child illiteracy in Ceará State decreased faster than in other Brazilian states. They have related this change to PAIC's action in reading and Mathematics' assignments, in elementary school. Although the Sociology of Education points out the correlation between socioeconomic level in localities and students' performance, Cruz, Farah and Ribeiro (2020, p. 1292) state that "in 2016, 54.76% of students enrolled in 3rd grade PS, in Ceará State, recorded insufficient reading skills, and it also pointed out similarity to, or even improvement, in comparison to São Paulo (58.65%), Espírito Santo (52.64%), Rio Grande do Sul (51.06%) and Rio de Janeiro (40.25%) states, which account for higher economic power than Ceará". Still, according to her, PS learning rates were better than the Brazilian average, in 2017: "school failure recorded 3.0% in the early school years and 6.1% in the final years of it; school

5- Data availability: the whole data set substantiating the results in the current study are available in dropbox and they can be accessed at <https://www.dropbox.com/sh/yadaygkqkq15nu8a/AAAwehZqog39NgTRgz0Q8CCla?dl=0>

dropout reached 0.5% and 2.2% at these same school years, respectively, and school approval was 96.5% and 91.6%, respectively” (p. 1295).

Equity outcomes detected in Ceará State are bond to the Brazilian context of new Post-1988 Constitution institutions (BRASIL, 1988). Article 205 of the Federal Constitution defines basic education as mandatory and subjective right to be ensured regardless of social markers. *Lei de Diretrizes e Bases da Educação Nacional n. 9.394* (BRASIL, 1996) [Law of National Education Guidelines and Bases] provides on “equal conditions of school access and permanence” and on “guarantee of quality standards” in its art.22. It also establishes basic education financing by FUNDEB, which is equally shared (BRASIL, 2020). Crahay (2000) and Ribeiro (2014) are among authors who advocate for the principle of ‘equity’ justice for basic education, according to which, educational policies must work for all, including those with lower resources or suffering with disadvantageous social relationships, so they can acquire the knowledge defined by the State as necessary – this concept is herein used.

One of Sociology of Education’s goals is to denaturalize school failures. In the last decades, it was possible observing efforts to identify phenomena accounting for educational inequalities that go beyond students’ social and cultural affiliation. There was progress in the process to identify intra-school factors capable of producing inequality in teaching, in teacher’s formation, in school organization and infrastructure, and, overall, in the administration profile of educational systems (BROOKE; SOARES, 2008).

Territorial and socio-spatial variables that can broaden educational inequality were also recently identified. These factors combine ways of taking public action to those featured by demographic and social nature (RIBEIRO, V.; VÓVIO, 2017). Researchers have shown that school enrollment regulations, discretion at decision-making at levels decentralized from the educational system and social representations of those accountable for implementing a policy at local level interfere with the provision of educational public services, depending on different social vulnerability levels in the territories (ALVES *et al.*, 2015). Educational public services also depend on demographic factors, such as population density in the territories and on economic properties at, and around, the school (ÉRNICA; BATISTA, 2012).

Recent national and international studies have focused on investigating school segregation influence over educational inequality in large cities’ territories, a fact that shines light on this phenomenon’s relevance (BEN AYED, 2012; RIBEIRO, V.; VÓVIO, 2017). According to Broccolichi, Ben Ayed and Trancart (2010), school segregation in urban territories is bond to populations’ spatial distribution in them. It is reinforced by practices put in place to break students’ allocation rules in schools and by the weight of private education. This scenario is also broadened by the impact of discretion played by agents in charge of implementing policies linked to initiatives at school and classroom scope. These authors have highlighted that school segregation in the territory is reinforced in high urban density and school areas, besides influencing students’ mobility among schools. Students with learning issues are allocated to the same schools, and it worsens their learning limitations. According to them, educational inequality is worse where school segregation is more visible. Broccolichi, Ben Ayed and Trancart (2010) and Ben Ayed (2012, 2013) contributed to change the association between education and school segregation in the territory as social issue in France, and it

led to guidelines about this topic in some legislations⁶. The National Education Ministry has published “Estado da escola” [School situation] on a yearly basis; this document provides on some territorialized indicators. “Geografia da escola” [Geography of school] includes indicators focused on social, economic and family in school environment; it is done by taking into account the territorial divisions. These studies are descriptive, and they are not necessarily driven by research hypotheses.

This sensitivity developed in France about the relevance of territorial factors reflected on new publications, such as “Atlas das fraturas escolares na França” [Atlas of School Fractures in France] (CARO *et al.*, 2010). The National Ministry of Education increased indicators’ production, like the social position index, which is more complex than common social-origin indicators and the students’ social position index (ROCHER, 2016). A typology of students’ enrollment spatialization in schools was introduced (DUQUET-METAYER; MONSO, 2019). Finally, an index to measure the distance of students’ performance according to their place of residence was created (MAUGIS; TOUAHIR, 2019). These indicators’ elaboration, at recent times, evidences the search for a prospective reflection about the State, when it comes to strategic territorialized school matters, mainly through the publication of a Ministry’ report relating “territorial distributions to school success” (AZÉMA; MATHIOT, 2019). However, despite new knowledge tools, mainly statistics and new factual elements in public policies, it is possible noticing only few changes in socio-spatial inequality configuration, and its impact on education, in the last decades. Such a hard time facing the problem is the result of the sense of territory, which is multi-sectoral and multi-shaped, since it combines demographic, economic and social elements. However, it is not limited to the school, but affects all State services available (BEN AYED, 2012; 2013; KAZTMAN *et al.*, 1999; KAZTMAN, 2001).

The current context, according to which, educational inequality still grows in France, is intriguing. Although the information disclosed above allowed stating that there were some upgrades in indicators’ production, educational research and guidelines that take into consideration the association between educational inequality and socio-spatial segregation, in France, nowadays, do not have synthetic indices, as recently observed in Brazil. These indices can help understanding territorial inequality at a broader level, if one takes into account the different dimensions forming them. It must be done to help carrying out further studies like the present one.

Operationalizing the sense of social vulnerability in the country

Since the 2000s, Brazil counts on synthetic-indices’ operationalization expertise to measure social vulnerability levels in the territories, and it led to the development of new research. According to Seddon (2014, p. 12), “Paraná, São Paulo, Rio de Janeiro and Amazonas are examples of states that developed methodologies to feature this population and to set different fronts to fight vulnerability”. These indices relate inequality-generating

6- Such as law n. 2013-595, from July 6th, 2013.

situations experienced by population living in the same territory; it aims at extrapolating the discussion about poverty (SEDDON, 2014).

These indices are substantiated by different references. “Índice Paulista de Vulnerabilidade Social (IPVS)” [São Paulo Social Vulnerability Index], for example, defines social vulnerability in the territory based on Kaztman *et al.* (1999) and Kaztman (2001). According to them, such a sociological phenomenon in Latin America relates to inequality overlapping, and it affects big cities, due to how these urban spaces were built. The poorer ones were sent out to peripheries where this population has lower schooling, poor access to new job positions and precarious housing, besides the loss-making presence of both the State and the market.

IPEA defined vulnerability based on Moser (1998) and Castel (1998), who somehow differ from some points addressed by Kaztman (2001). It is more centered on how urban center in Latin American countries were built, a fact that led to unequal opportunities. Castel (1998) focused on the association between the social division of labor and the social protection provided by both the State and society. Castel (1998) advocated that there is strong correlation among occupied spaces in the social division of labor, participation in social networks and in protection systems that guarantee safety for individuals, given life’s random events. This author has explained contemporary social inequality, which can be thought based on social cohesion ‘zones’, namely: 1) disaffiliation, social cohesion zone, which expresses the sum of two social situations, lack of participation by any productive activity added to relational isolation; and 2) social vulnerability, which would be an intermediate zone between social insertion and disaffiliation – it is featured by precariousness at work and weak relational insertion (CASTEL, 1998). Moser (1998) assessed how the poverty issue is configured in developing countries; she concluded that individuals could have their well-being compromised by their hard time accessing “material and symbolic assets” (such as a job and education).

Although definitions by Kaztman *et al.* (1999) and Kaztman (2001), and Moser (1998) and Castel (1998) are not identical, indices’ operationalization resembles each other when indicators selected to express their concept are observed – they seek to use those that express a set of situations experienced by people or social groups that live in certain spaces; it territorializes their social insertion, the State/market relation and the opportunities to reach a dignifying life. Despite the differences, Castel (1998), Kaztman *et al.* (1999), Kaztman (2001) and Moser (1998) work with the sense of social vulnerability as driving by precarious access to situations that allow social insertion and ensure bonds and protection against random life events.

According to Marco Costa and Bárbara Marguti (2015) and Costa *et al.* (2018), IPEA selected Social Vulnerability Index (SVI) indicators that express lack or insufficiency of assets capable of enabling well-being or social bonds that ensure social protection (income flow, proper housing, drink water supply and basic sanitation service; access to public health services; access to health, school and good-quality public transportation, among others). These services can be provided by the State; they set contemporary society’s well-being conditions. Populations that experience social vulnerability condition can be spatially identified.

Based on these indices' aims and theoretical fundamentals, as well as on the outcomes of French studies, the political dimensions of sense of social vulnerability in the territory must be highlighted. Governments, by seeking to broaden their action in social policies, believe that, based on tools that allow separating populations based on socio-spatial inequality, it is possible better understanding their needs and bringing improvements to the locations they live in, by focusing on their actions. Evidences show that the created indices influenced public policy design in Brazil. According to Melo (2020), there are programs created at federal scope that take into account different social vulnerability levels in the territories, such as "ProInfância" [Pro-childhood] and "Brasil Carinhoso" [Tender Brazil]. This author assessed these policies' implementation in Rio Grande do Norte State, and stated that the guideline to meet the vulnerability situation in the territory found a whole series of barriers, such as lack of technical skills in municipalities that match the vulnerability criterion, mismatch between legislation requirements and terrain specificities in these territories - these factors impair the construction of daycare centers. These data have shown the relevance of research about public policy implementation, mainly those focused on social vulnerability issues in the territories to achieve effective distribution of rights (MELO, 2020).

The sight over social vulnerability in the territories boosted research in the Sociology of Education field, both in France and in Brazil. Based on Vanda Ribeiro, Hivy Mello and Antonio Batista (2015), Brazilian studies on school inequality and social vulnerability in big cities' territories are recent; they were developed by researchers from 'Observatório das Metrôpoles' [Metropolises' Observatory], by 'Centro de Estudos sobre as Metrôpoles' [Center of Studies on Metropolises]. In the last few years, it has been carried out by 'Centro de Estudos e Pesquisas sobre Educação, Ação Comunitária e Cultura' (CENPEC) [Center for Studies and Research about Education, Community action and Culture].

Vanda Ribeiro and Claudia Vóvio (2017) analyzed research carried out in these centers that are indexed in Scielo platform, in April 2015, and in other associated publications. These authors stated that, according to these studies, students' performance in schools located in these territories tend to lower learning levels (RIBEIRO, L.; KOSLINSKI, 2009; ÉRNICA; BATISTA, 2012; KOSLINSKI; ALVES; LANGE, 2013; TORRES *et al.*, 2008; BARBOSA; SANT'ANNA, 2010; ÉRNICA; BATISTA, 2012). Vanda Ribeiro and Claudia Vóvio (2017) stressed that, according to the analyzed studies, social vulnerability in the territory produces school inequality due to mechanisms, such as lack of State investment in child education (ÉRNICA; BATISTA, 2012); social representations unfavorable to populations living in these city areas (ALVES *et al.*, 2015; TORRES *et al.*, 2008; BARBOSA; SANT'ANNA, 2010); lack and shortage of good public-equipment infrastructure in vulnerable territories (ÉRNICA; BATISTA, 2012; TORRES *et al.*, 2008); teachers with better qualification and expertise who migrate to less vulnerable territories (ALVES *et al.*, 2014); higher frequency of substitute and temporary teachers in peripheral regions (TORRES *et al.*, 2008); higher teachers' turnover in schools (TORRES *et al.*, 2008); issues regarding the effectiveness of teachers' continuous formation policies (BRECHES, 2015; MARCUCCI, 2015); competitive interdependence relationships among schools (TANGERINO-SILVA, 2016; BATISTA; CARVALHO-SILVA, 2013); not following the prescribed discipline matrix (MARCUCCI, 2015); legislations that boost practices unfavorable for vulnerable territories (TANGERINO-SILVA; 2016).

We also searched at Scielo for new articles to complete the research by Vanda Ribeiro and Claudia Vóvio (2020). It was done in April 2020, and was based on the keywords “social vulnerability and education”. Seven new articles were selected for matching the present research. Almeida (2017) analyzed school data about different social vulnerability levels, in Campinas City, and concluded that territorial dimension influences likely educational work in schools. This author corroborated the existence of competitive interdependence among schools, in vulnerable territories: “the best schools evaluated by the population and by professionals, in an informal way, are those chosen by families, they are the ones with socialization model close to that in school environment. This scenario leads to some school segregation due to family choices (ALMEIDA, 2017, p. 379).

Souza, Panúncio-Pinto and Fiorati (2019) applied a questionnaire and adopted qualitative research techniques to assess families in Ribeirão Preto’s periphery, based on social vulnerability. They state that “teachers do not seem ready to deal with these children and adolescents’ suffering and difficulties, or to create a more encouraging and cozy environment” (SOUZA; PANÚNCIO-PINTO; FIORATI, 2019, p. 266). Souza, Panúncio-Pinto and Fiorati (2019) stated that the assessed families do not acknowledge the school as their kids’ formation space, different from what is stated by Batista and Carvalho-Silva (2013).

Matheus and Oliveira (2018) assessed the consequences of social vulnerability for youngsters living in São Paulo’s periphery. They have concluded that schools are important public equipment that suffers with distress experienced by youngsters and adolescents, due to the territory’s institutional features. According to them, these schools present difficulties linked to infrastructure, management and to teachers’ staff, whose labor conditions do not allow their constant presence and bonds’ construction. This scenario is felt by youngsters; therefore, it becomes the reason for lack of commitment to the institution. Despite this problem, these authors approach potentialities by trying to understand the work done by two schools that deal with such difficulties; they mentioned the following practices to overcome and to live with conflict: dialogue, negotiation, reciprocity, trust, respect and joint decisions about management (MATHEUS; OLIVEIRA, 2018). This research corroborates Torres *et al.* (2008) and Alves *et al.* (2014) about the hard time retaining teachers in these territories, and Torres *et al.* (2008) about the worse infrastructure issue.

Villamizar Santamaría (2015) investigated the association between afro-descendant population segregation and access to public assets in Bogota City, Colombia. This author has stated that this city has been adopting a redistributive logic as attempt to reduce inequalities. However, the location for public assets’ offering was found in regions accounting for the largest white and brown population, rather than locations standing out for larger black population. According to him, this offer’s configuration impairs the access of the black population to public assets.

Matheus (2019) assessed youngsters in two neighborhoods in São Paulo known for being vulnerable territories. He has observed that schools have a hard time meeting this population’s expectations and answering to their problems, and it contributes to school dropout by students lesser adjusted to the teaching system. According to him, “youngsters who do not get to identify themselves with the pedagogical development proposition, be it due to difficulty with their own learning, which is far from the reference field of local reality, or to conflict between the expectations and demands by the formal and informal media,

which are often entangled aspects”. He has stated that the articulation between schools is weak, “and it ends up limiting the action potential of each equipment in its specific reality and of the set of organizations, as a whole, in the territory” (MATHEUS, 2019, p. 8).

Gadea *et al.* (2017) addressed the situation of youngsters who live in vulnerable neighborhoods in Port Alegre City. These authors observed that school dropouts in the age group 14/15 years, in addition to more external family vulnerability situations, end up “pushing” youngsters to sociability networks that can lead to conflicts with the law. They also understand that there are indicatives that “these youngsters’ biggest need is ‘social capital’ to enter a social relationships’ network capable of allowing them to get rid of ‘undesirable situations’” (GADEA *et al.*, 2017, p. 295). Based on Matheus (2019) and Gadea *et al.* (2017), it is possible inferring that schools in vulnerable territories have a hard time providing the necessary opportunities for youngsters who experience the overlap of inequality situations typical of the social vulnerability phenomenon in order to have a good school trajectory and socio-cultural opportunities, as established by the legislation in the country.

Kelen Ribeiro *et al.* (2018) sought to understand the association between education and health in a high social vulnerability neighborhood called Bom Jardim, in Fortaleza City, Ceará State. They have stated that access to school was broadened in the last years of school, and it had positive effect on the senses and behaviors that positively influence health. This study corroborates Érnica and Batista (2012), because Bom Jardim lacks daycare centers, and this factor has negative influence on the population’s education, according to them. They point out the precarious infrastructure of public services, including the educational ones, and it corroborates findings by Torres *et al.* (2008).

There is new information in the 2020 screening in comparison to texts analyzed by Vanda Ribeiro and Claudia Vóvio (2017): 1) rise of association among youngsters, sociability and school education in vulnerable territories as study object; 2) search for understanding the interface among racial issues, access to social assets and social vulnerability in the territory; 3) studies outside the Rio/São Paulo axis, and abroad, because there was a research carried out in Porto Alegre, another in Fortaleza and one in Colombia; 4) investment in identifying factors related to overcoming difficulties in vulnerable territories; 5) new academic centers focused on research about this topic. There was no quantitative research aimed at learning about association between educational equity and social vulnerability in the territories, by Vanda Ribeiro and Claudia Vóvio (2017), or in the 2020 screening. The present article contributes to knowledge by making connections between these two phenomena, in Ceará State and in Fortaleza City. It takes into account that these locations have become cases assessed based on the remarkable evolution of PS students’ education performance and on school inequality reduction, when data in ‘Prova Brasil’ were assessed (KASMIRSKI; GUSMÃO; RIBEIRO, 2017; MAMEDE *et al.*, 2021).

Methodological procedures

The present research followed the quantitative approach. According to Gatti (2004), despite its limitations, this approach is essential because it provides a broad overview of social issues. The following methodological choice was made to operationalize a

measurement to express the herein adopted concept of equity: we used data from “Prova Brasil” for 5th grade primary school students provided by “Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira” [Anísio Teixeira National Institute of Educational Studies and Research] (INEP, 2011, 2017). Reading performance was adopted as knowledge measurement⁷. Gender, race and students’ families purchase power were used as social markers. Although we accept the external evaluation limitations of “Prova Brasil”, because it does not express the whole learning basic education students need to develop at school, this article uses its results as distribution indicator applied to part of the Portuguese-Language knowledge expected to be taught, because its evaluation criteria express relevant knowledge bases essential for a proper learning. According to Crahay (2000), students’ performance measurements deriving from large-scale tests are one of the means to assess equity’s reach within an educational system when the focus lies on the relevance of knowledge distribution – it is the very target of the present study.

Purchase power (proxy to economic capital) was expressed by an adapted version of *Critério de classificação econômica Brasil* [Brazil economic classification criterion] (ABEP, 2011), which is a system to score the number of comfort items, like TV and refrigerator, and the household’s schooling; yet, based on the final score, it classifies residences within one of the Criterion’s economic classes (A1, A2, B1, B2, C1, C2, D and E). This Criterion was adjusted to deal with differences between required information and those found in ‘Prova Brasil’ contextual questionnaires, which can change over its different editions or even present high no-response rate. The choice for Brazil Criterion was linked to its easy calculation and interpretation.

Territory vulnerability was measured through SVI and IPEA, which use data from the 2010 demographic census (IPEA, 2020). It regards the initiative focused on geo-referencing indicators, so that it allows visualizing life conditions in different locations in Brazil (COSTA *et al.*, 2018). SVI lists 5 vulnerability levels: very low, low, medium, high and very high. This list was developed based on indicators gathered into three dimensions: urban infrastructure, human capital and income, and labor, which express the difficulty in accessing the following active and symbolic materials, respectively: (i) basic sanitation and urban mobility, (ii) health and education, and (iii) current income and income insecurity. The index is calculated for municipalities and for Human Development Units (HDU), which are territorial cuts located in metropolitan zones that gather IBGE’s census sectors, based on their socioeconomic homogeneity (COSTA; MARGUTI, 2015).

The combination of ‘Prova Brasil’ and HDU’s SVI was made through schools’ geo-referencing. Schools’ geographic coordinates were found in *Google Cloud Platform*, in *R software*. Search parameters were school name, municipality and location state in School Census. With respect to schools in Fortaleza Metropolitan Region, addresses were provided by Ceará State Secretariat of Education. We used Stata/MP 13.1 and IPEA shapes to place school’s coordinates in HDUs.

Proper reading proficiency in 5th grade was understood as basic reading skill acquisition, which is essential to learn contents of other necessary education stages,

7- The option for using Portuguese Language Scores is linked to the fact that the present article is the outcome of a larger research, as already mentioned, which is funded by Fapesp process 2018/11257-6. It comprises experts who aimed at observing and analyzing teaching-learning actions in the discipline, in classroom environment.

without which, students are left to a disturbed school trajectory and to lack of both the respect and acknowledgement necessary for school insertion and for a dignifying social life (RIBEIRO, V., 2014). Proper reading performance herein considered the means to reach, at least, 200 points in Saeb scale established by ‘Todos pela Educação’ [All for Education] (2007).

The FGT(3) index by Foster, Greer and Thorbecke (1984)⁸ was selected as equity indicator. These authors developed and broadened a class of FGT indicators applied to income distribution in order to measure poverty. We propose the application of 1 class indicator, parameter α , which regards proficiency distribution to measure equity.

FGT Index class is defined through the equation below. Proficiency was dealt with in a similar way to that adopted to income and proper performance level as poverty line.

$$FGT(\alpha) = \frac{1}{n} \sum_{i=1}^q \left[\frac{(z - T_i)}{z} \right]^\alpha, \alpha = 0,1,2,3, \dots$$

Wherein, z is proper performance, T_i is student i 's score, n is population size in the analysis and q is the number of students with score lower than z . Equity index allows comparing the score distributions of a given value, and ordering them from the most equitable (lower value) to the lesser equitable (higher value). It is possible simultaneously comparing different schools (or classes, networks, among others) or comparing the same school at different moments in time. When $\alpha=3$, FGT(3) embodies values ranging from 0 to 1, and (0) zero represents the best equity situation.

Poverty measurements are more suitable to deal with equity than the income inequality ones. The most often used inequality indicators, such as Gini Index, are based on income ratio individuals live on. Because proficiency is the variable of interest, we learned that it would not make much sense to analyze the total-learning share recorded for the students, since knowledge is a non-rival asset.

The higher the α , the more the indicator meets the desirable features. FGT indices presenting $\alpha > 2$ are oversensitive to what happens in the lower tail of grades⁹ distribution, and it sets an association with the sense presented in the special-attention theoretical fundamentals applicable to those who show higher school difficulties. Another advantage of it lies on the fact that FGT indices can be subdivided into subgroups and the indicator of a given population is the weighed mean of indicators for subgroups. The indicator of a given teaching network, such as school in different vulnerability limits, contributes to the network's general index. This feature is essential, if one has in mind that the least favored ones in social assets' distribution tend to learn less (BROOKE; SOARES, 2008).

Indicators' standard error was calculated through the bootstrap command in Stata MP 17, with 400 repetitions. Davidson and Flachaire (2007) show that using the bootstrap is a good tool to make inferences to FGT poverty measurements, as long as the observation number

8 - There are other ways to conceptualize and operationalize the sense of equity and educational inequality. See Vanda Ribeiro (2012, 2016), Érnica and Castilho (2020), Soares and Delgado (2021) and Waltenberg, Simielli and Soares (2021).

9 - Besides reflection, transitivity, anonymity, population and homogeneity axioms, they meet monotonicity, transfer and transfer sensitivity. See Foster, Greer and Thorbecke (1984).

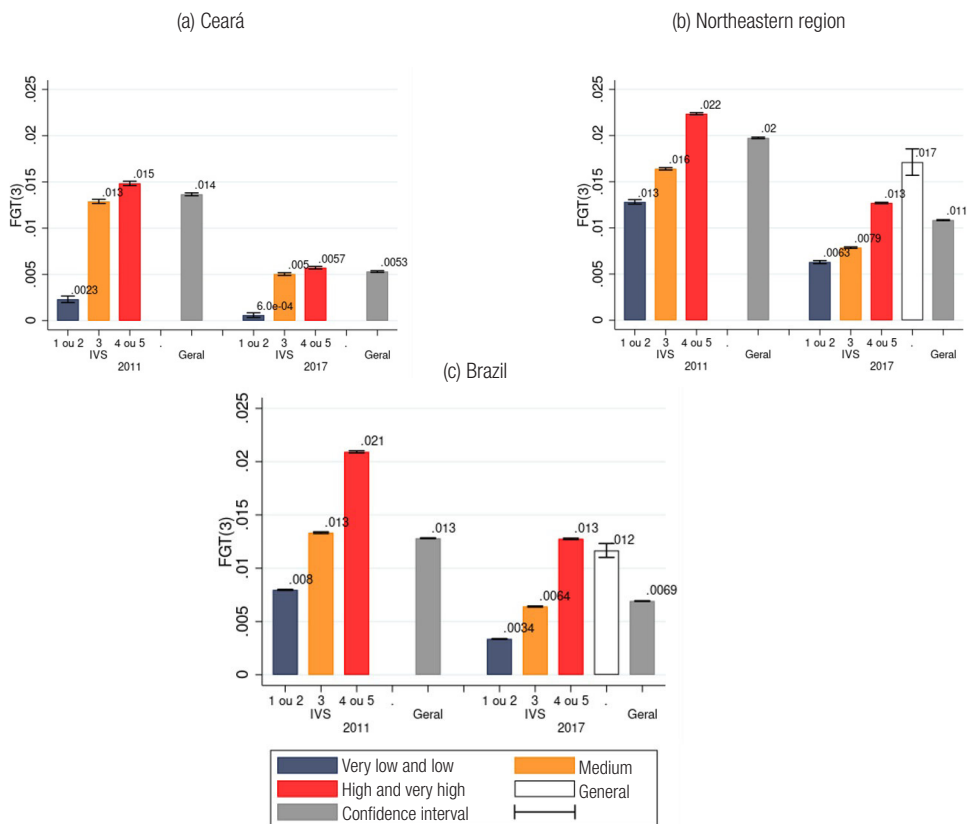
below poverty line is higher than 10 and the poverty line is exogenous or estimated based on the function of any quartile. Both conditions are fulfilled in the application procedure.

Results presentation and discussion

FGT(3) calculated for the following cuts are introduced below to assess equity evolution: vulnerability limit of the school’s territory, calculated in separate, and its combination to social groups defined based on students’ race/skin color, gender and economic class.

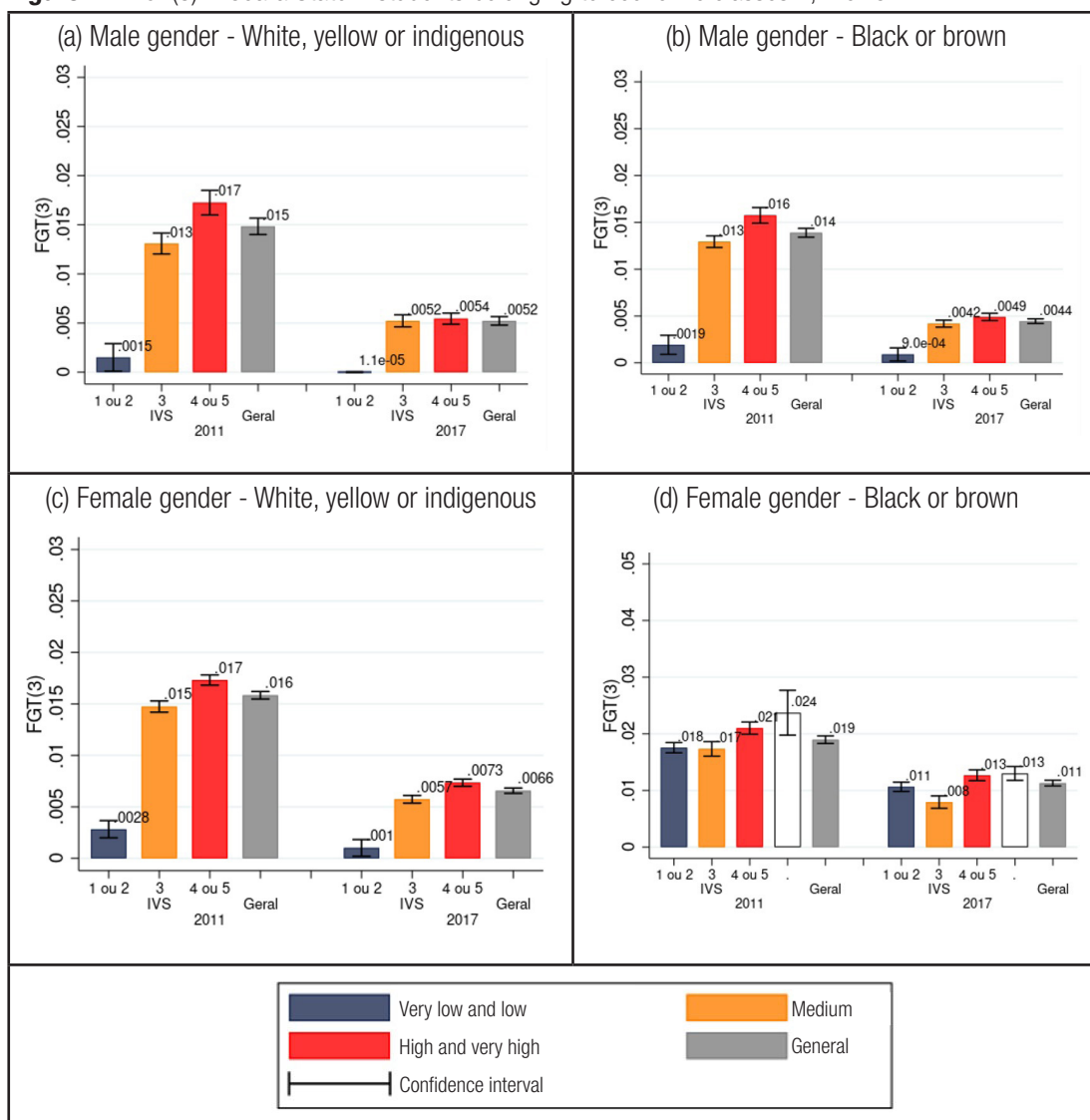
Equity indicators based on vulnerability and general limits for Ceará State, Northeastern region and Brazil are shown in Figure 1. Based on this figure, between 2011 and 2017, all geographic and vulnerability indices have improved. Ceará State’s indicators reached lower levels (statistically different from those recorded for the other regions) and drastically dropped down in comparative terms; differences between students’ vulnerability in municipal schools in the territories ranged from medium to very high.

Figure 1 - FGT(3) – Ceará State, Northeastern region and Brazil – general and based on municipal SVI limits



Source: Elaborated by the authors based on data in Prova Brasil/INEP, IPEA, GeoSampa and Google Cloud Platform. Notes: C.I. confidence interval; 95% confidence interval. The rates of students without SVI were 0.2% and 0.3%, respectively, in the Northeastern region and in Brazil, in 2017.

Figure 2 – FGT(3) – Ceará State – students belonging to economic classes A, B or C1



Source: Elaborated by the authors based on data in Prova Brasil/INEP, IPEA, GeoSampa and Google Cloud Platform. Notes: C.I. confidence interval; 95% confidence interval. The rates of students without SVI were 0.2% and 0.3%, respectively, in the Northeastern region and in Brazil, in 2017.

Given the features addressed in the previous section, improvement, or in equivalent terms, FGT(3) index decrease, can express the fact that children with grades lower the 200 points, mainly the ones most distant from this value, thrived or, at least, did not get worse, rather than just expressing increase in the rate of students accounting for proper grades. This is the main advantage of FGT indices presenting $\alpha > 2$ in comparison to the

rate of students with grades lower than 200 points, with average proficiency or learning gap between different social groups.

In 2011, Ceará State was more equitable than the Northeastern region and Brazil, at all SVI levels, and it recorded average rates in comparison to its own region. The general Brazilian indicator is lower than that recorded for Ceará State, because of differences in the weight of each vulnerability level. Ceará has many students in the medium and high SVI regions, and fewer students in the low and very low SVI region, in comparison to Brazil. It is important recalling that the general index can be expressed as the weighed mean of indicators based on SVI.

Results based on Ceará's inequality markers – SVI and social groups – are shown in Figures 2 and 3. Equity improvement in all social groups, within all vulnerability limits, between 2011 and 2017, stands out in both figures. Equity improvement benefited all territory types and social groups.

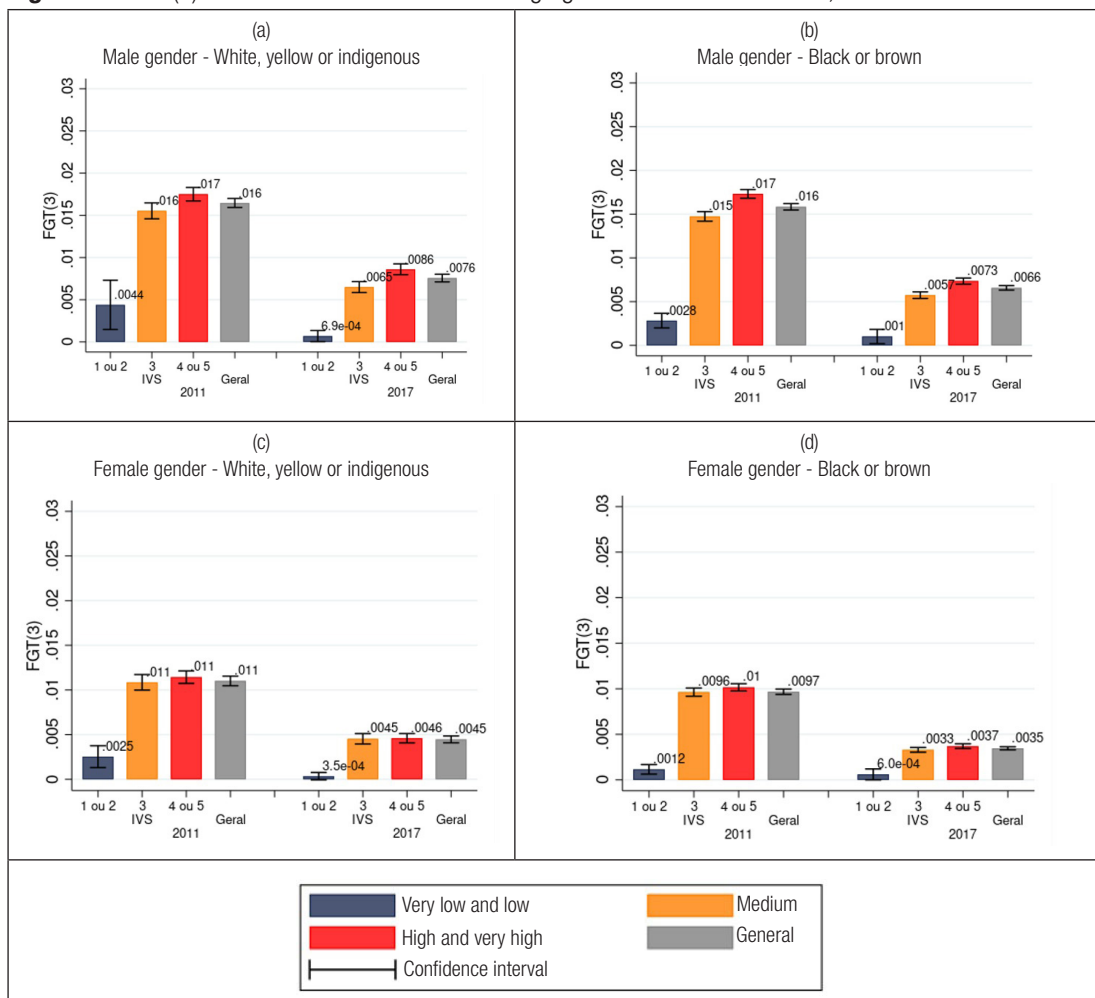
In 2011, we almost did not detect significant equity differences between races, in statistical terms, by keeping constants 'economic class' and 'gender'. It can be observed between boys in the highest classes when we compare the four first columns in panel (a) to the first four columns in panel (b), in Figure 2. The same is observed for boys in the lowest classes (see Figure 3, below). It can be seen among girls in the highest classes when we compare the first four columns in panel (c) to the first four columns in panel (d), in Figure 2. Figure 3 shows the lowest classes' students; there is small difference among them, but it is statistically significant and benefits black girls when SVI is 4 or 5 (it points out higher social vulnerability levels) or when we take into account the general indicator.

If, in 2011, we almost did not detect differences between races, regardless of economic class or gender, 2017 data highlighted a different scenario. As shown in Figures 2 and 3, black students belonging to both genders, from the highest and lowest economic classes, presented general equity indicator slightly better than the whites, yellows and indigenous. When we observed different social vulnerability levels in 2017, we found equity between black boys belonging to the highest classes in low and medium vulnerability schools, as well as between black boys belonging to the lowest classes who attend schools in high vulnerability territories, and among black girls belonging to the lowest classes in territories scoring SVI ranging from 3 to 5.

It is possible stating that there were improvements in equity in the herein assessed years when the study analyzed the situation of black girls in the most vulnerable territories. The same is found whenever we observe black boys either in the best economic situations or experiencing more adverse conditions.

When we analyze students from different economic classes, belonging to the same gender and race, it is possible noticing the best position lived by students in the highest classes, in 2011 and 2017, except when the school is located in low vulnerability territories (compare the same panels between Figures 2 and 3). This advantage was reinforced in 2017, because there was no difference between indices recorded for white, yellow or indigenous girls from different economic classes, at any SVI, in 2011. However, a difference that benefits these girls emerged in 2017 in medium to high vulnerability territories.

Figure 3 – FGT(3) – Ceará State – students belonging to economic classes C2, D or E



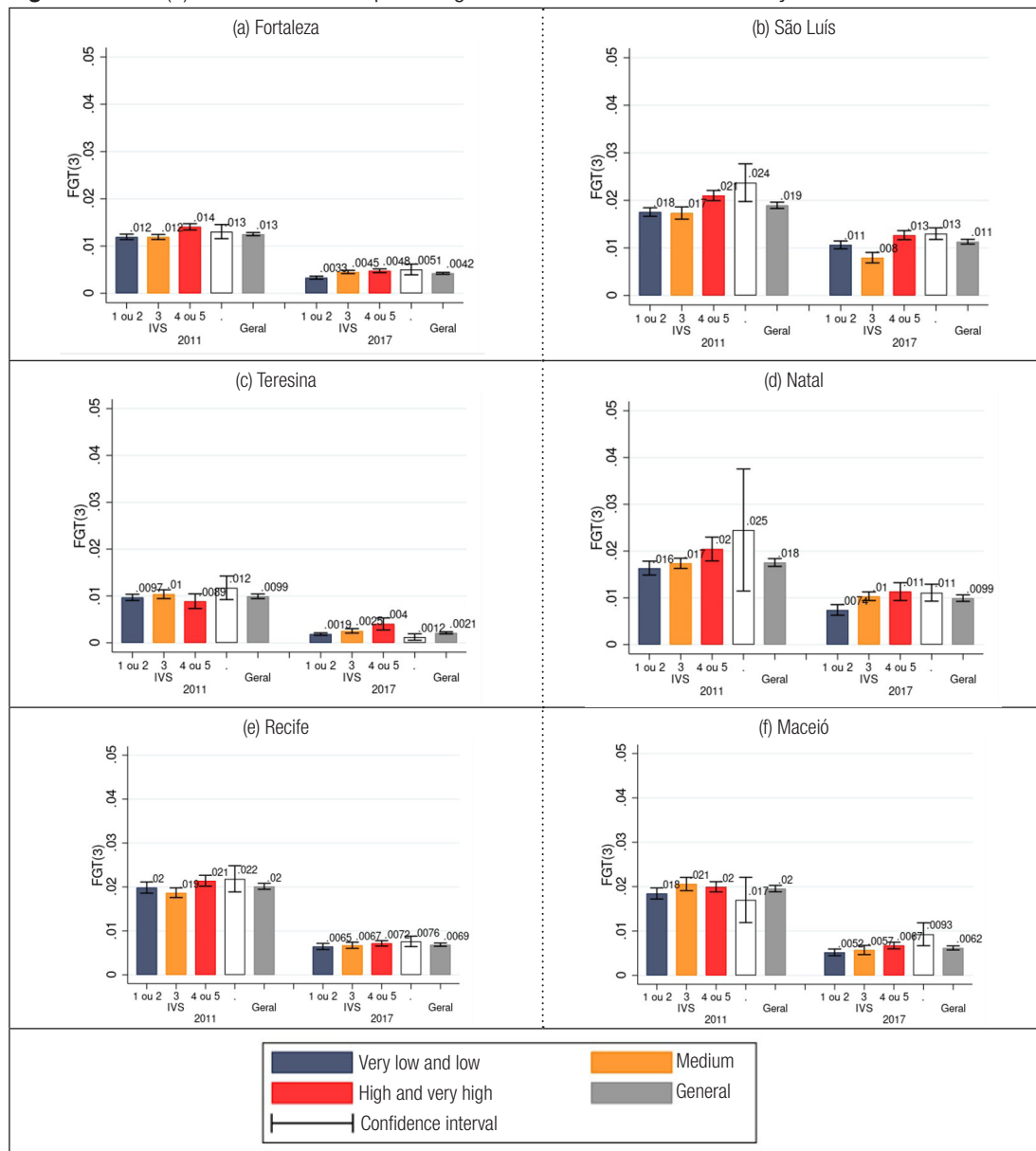
Source: Elaborated by the authors based on data provided by Prova Brasil/Inep, IPEA and Google Cloud Platform. Notes: C.I. confidence interval; 95% confidence interval.

When we compare panels (a) to (c) or panels (b) to (d) in each figure (by keeping the class and the race unchanged and by only changing the gender), it is possible observing more equity among girls than among boys. This finding does not happen in schools located in low vulnerability zones.

Briefly, Ceará State evolved in terms of equity, and reached indicators better than those recorded for the Northeastern region and Brazil, in almost all social groups and vulnerability levels. Still, some differences remain between genders and classes, and differences between races that did not exist in 2011 emerged in 2017, mainly in medium to very high vulnerability schools.

Figure 4 shows FGT(3) indicators recorded for part of Northeastern capitals¹⁰, in general terms and based on HDU's SVI. Indicators' standard deviation was higher than that recorded for Ceará.

Figure 4 – FGT(3) – Northeastern capitals – general and based on vulnerability limits set for HDU's SVI

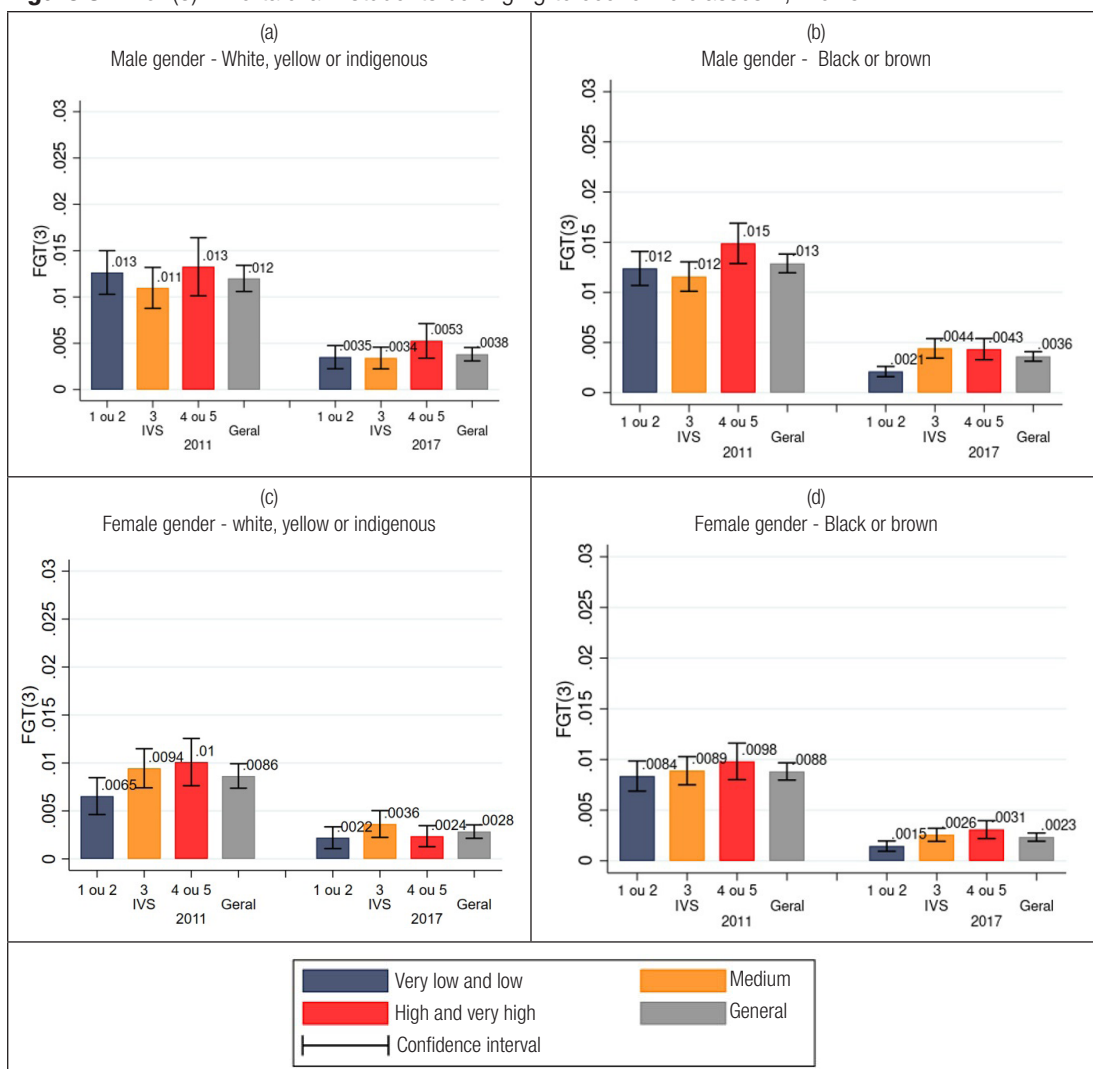


Source: Elaborated by the authors based on data provided by Prova Brasil/Inep, IPEA and Google Cloud Platform. Notes: C.I. confidence interval; 95% confidence interval.

10- It was not possible comparing Fortaleza to Aracajú and João Pessoa, because IPEA did not calculate the metropolitan SVI of these capitals, and results were not compared to Salvador due to technical issues (unidentified coordinate system).

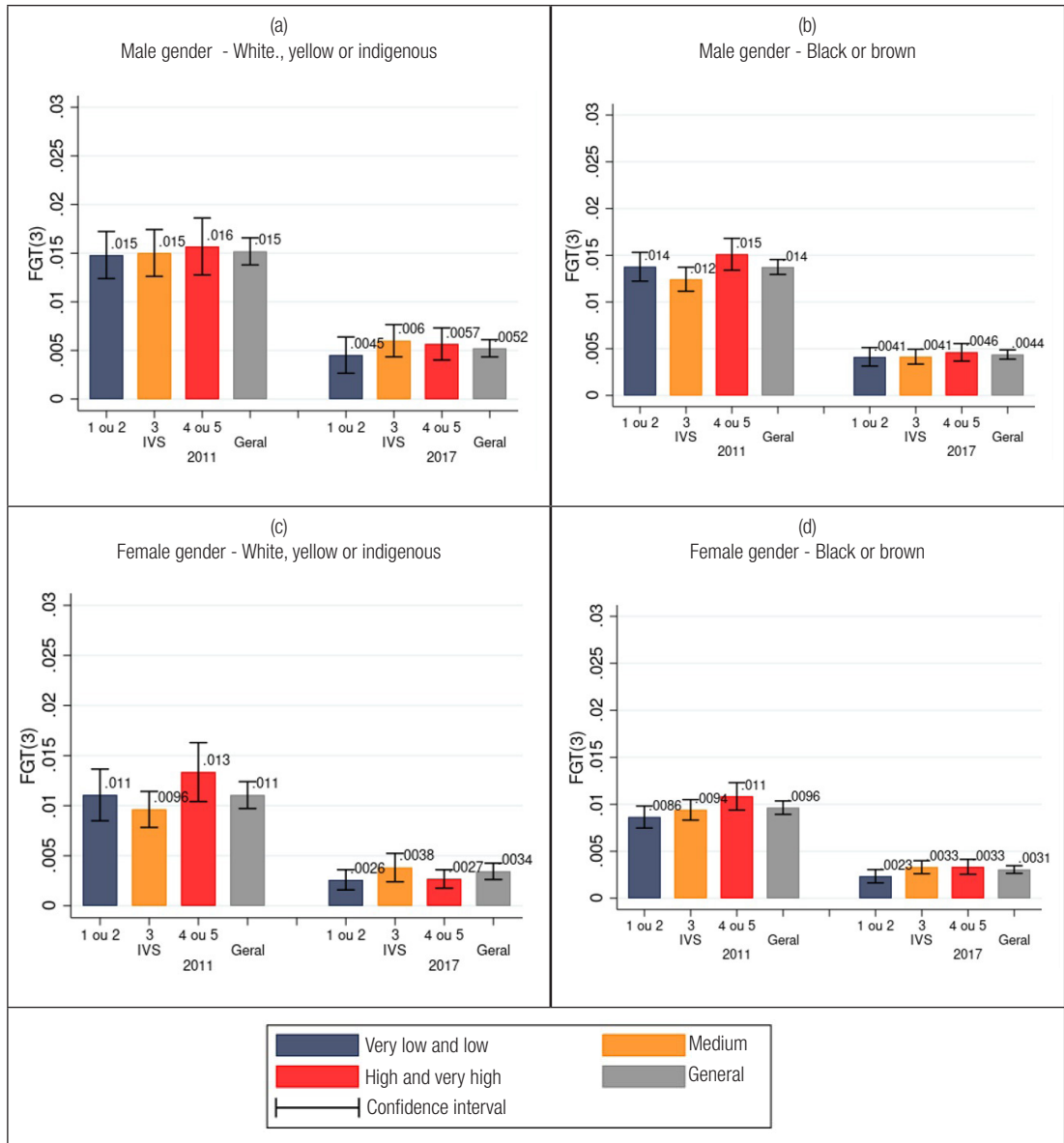
Fortaleza was the capital accounting for improvements in all social vulnerability groups (Figure 4) and socioeconomic cuts (Figures 5 and 6). In 2017, this capital recorded the best general result and the best equity SVI in comparison to the other analyzed Northeastern capitals, except for Teresina, the capital of Piauí State. Fortaleza increased students' scores after implementing strategies provided on PAIC (MAMEDE *et al.*, 2021), as well as got to improve equity in all social vulnerable limits of the territory and in the herein adopted social groups, between 2011 and 2017. We did not find differences between social groups in Fortaleza (Figure 5 and 6), because the indices' standard deviation was high due to the small number of students in each cut.

Figure 5 – FGT(3) – Fortaleza – students belonging to economic classes A, B or C1



Source: Elaborated by the authors based on data provided by Prova Brasil/Inep, IPEA and Google Cloud Platform. Notes: C.I. confidence interval; 95% confidence interval

Figure 6 – FGT(3) – Fortaleza – students belonging to economic classes C2, D or E



Source: Elaborated by the authors based on data provided by Prova Brasil/Inep, IPEA and Google Cloud Platform. Notes: C.I. confidence interval; 95% confidence interval.

Results in the current study corroborate those by Padilha *et al.* (2013), who stated equity broadening in EF1, in Ceará, and by Kasmirski, Gusmão and Ribeiro (2017), according to whom, besides its broadening profile, PAIC is also accountable for part of

this improvement, because it encouraged students in the poorest localities to reach the expected educational outcomes. This research adds an important result to the literature: this equity broadening in Ceará State also benefits territories presenting the highest social vulnerability (gender, race and economic class) and who lives in them. Fortaleza took a similar path when it comes to broadening equity in different territories, but, due to the indices' low accuracy, it was not possible observing the behavior of social markers (race, gender and economic class) in interface with these different social vulnerability levels. These results are unusual if one takes into account the literature about association between education social vulnerability in the territory (TORRES *et al.*, 2008; RIBEIRO, L.; KOSLINSKI, 2009; BARBOSA; SANT'ANNA, 2010; ÉRNICA; BATISTA, 2012; KOSLINSKI; ALVES; LANGE, 2013; MELLO, BATISTA, RIBEIRO, 2015; RIBEIRO, V.; VÓVIO, 2017), which has evidenced lower students' performance in the highest social vulnerability locations.

It is necessary observing the meaning of comparing equity results between Fortaleza and Teresina; in 2017, Fortaleza recorded very high rate of PS 5th grade students' participation in 'Prova Brasil' (98%), whereas this rate in Teresina reached 81%, as shown in Table 1.

Table 1 – Rate of municipal enrollments' participation in 'Prova Brasil'

Region	% PS 5th grade students			
	Municipal enrollments in public networks		In 'Prova Brasil' of municipal networks	
	2011	2017	2011	2017
Brazil	76	82	75	83
Northeastern region	89	95	63	78
Maranhão	91	97	56	72
Piauí	83	98	52	76
Ceará	98	99	78	93
Rio G. do Norte	74	79	65	76
Paraíba	73	84	54	74
Pernambuco	87	98	63	79
Alagoas	90	95	66	79
Sergipe	73	78	61	78
Bahia	96	99	62	75
São Luís	67	80	88	85
Teresina	74	91	84	81
Fortaleza	92	99	91	98
Natal	62	69	80	86
João Pessoa	61	71	81	84
Recife	80	98	80	81
Maceió	67	78	83	79
Aracaju	44	54	82	87
Salvador	85	96	81	80

Source: Elaborated by the authors based on INEP data.

Table 1 also shows that Ceará State keeps almost all SP enrollments, at the collaboration pact scope, in municipal networks, as stated in the beginning of the present article. Participation rate recorded for PS 5th grade students in 'Prova Brasil', in 2017, was much higher than that in other Northeastern states, in this region and in the country than the average of both this region and Brazil. Between 2011 and 2017, there was a huge improvement in this Prova Brasil-participation rate in Ceará State.

Final considerations

The aim of the present article was to assess the association between educational equity in municipal public primary schools in Ceará State and in Fortaleza City, and social vulnerability in the territory, between 2011 and 2017. Two different indicators were compared: one to measure social vulnerability levels (through Social Vulnerability Index – IPEA's SVI) and another to measure equity (FGT(3) indicator), by taking into account the performance of PS 5th grade students in 'Prova Brasil', and their socioeconomic features, which would allow creating social groups based on traditional inequality markers set by Sociology – gender, race/color and economic class. The concept of equity that has substantiated the index lies on the assumption that all students must reach the level seen as appropriate by the State, at the stage they are in, regardless of origin situation (CRAHAY, 2000; RIBEIRO, V., 2014). The concept of social vulnerability results from studies by Moser (1998) and Castel (1998).

Results have shown more intense education equity, between 2011 and 2017, in Ceará than in the Northeastern region, and it is expressed by smaller correlation between social vulnerability of the territory and adequate learning level, within the school dropout and failure context. It was done by observing results based on class, gender and race/color, which allowed observing that different social groups were benefited, including those traditionally more often excluded from knowledge distribution processes. This is the case of black girls in the most vulnerable territories and that of black boys, either in the best economic situations or in more adverse conditions.

Fortaleza case was assessed by comparing it to other Northeastern capitals. Results pointed out equity improvement in the territories, and high and medium social vulnerability. Teresina stood out among capitals whose situations were compared, but it recorded lower students' participation in 'Prova Brasil'.

The present results were recorded at PAIC enforcement time (this is a governmental program in Ceará State developed in partnership with municipalities), and this is why it is essential understanding how this program was implemented. Ribeiro, Kasmirski and Gusmão (2017) used the *dif in dif* methodology and showed that PAIC is accountable for explaining part of the equity results recorded for education in Ceará State. Analyzing Program strategies, who their implementing agents are, as well as their interactions, may contribute to the process to design and implement educational public policies aimed at coping with inequality.

The literature on PAIC approaches different implementation profiles and seeks to explain educational results in Ceará State. Vanda Ribeiro, Alicia Bonamino and Sergio Martinic (2020) sought to understand the Program's regulation model. They observed

different instruments that make implementing agents act to accomplish common goals, and it has positive influence on relationship aspects among agents. According to these authors, this aspect helps explaining educational-equity broadening in the State. They state that the regulation model derived from pattern demands and from surveillance over results and processes focused on correcting trajectories. According to Crahay (2000), this is a policy type capable of generating equity. When it comes to relational aspects in PAIC implementation, Vieira and Vidal (2013) state that this educational policy and its outcomes also regard collaboration between state and municipalities, which is supported by negotiation and collaboration between schools. Collaboration between schools was treated as relevant PAIC aspect by Calderón, Raquel and Cabral (2015).

Cruz, Ribeiro and Batista (2022) assessed the PAIC implementation context and showed the existence of political continuity, based on Post-1988 Constitution inheritance. They state that the governor who created it in 2007 protected decisions made by high and middle level implementing agents, given political demands against the needs of the herein described panorama. Based on discussion about this topic, the authors believe that there was state capacity amplification in Ceará State. According to Gomide and Boschi (2016): bureaucracy increase, leadership using and the expertise of implementing technicians, as well as the distribution of knowledge acquired by these agents are the means to boost this policy. They stress that, although the context in Ceará State is featured by low tax collections, there was good use of, and negotiation about, public resources' distribution. Results in the current study also shine light on Ceará's state-capacity increase in comparison to other aspects approached by Gomide and Boschi (2016): incidence on inequality.

Ribeiro, Cruz and Santos (2023) analyzed interviews with teachers, managers and observation records from classroom, carried out in a school located in a high vulnerability territory, in Fortaleza, to understand PAIC implementation. They state the support given by part of managerial bureaus to the network the assessed school belongs to; it is done so that its professionals can play their parts well. This support has "cascade" profile, and starts at PAIC, which is a state Program, crosses regional districts and municipal secretariats, and reaches the micro scale: the school.

Kelen Ribeiro *et al.* (2018) aimed at understanding associations between education and health in Fortaleza by interviewing local leaderships in neighborhoods classified as of the high social vulnerability group, and stated that in the last few years one could witness broader access to education in this locality. This process has positive impact on the population's behavior regarding care with health. The study by Kelen Ribeiro *et al.* (2018) reinforced the association between PAIC arrival in vulnerable regions and positive changes in public education.

Anjos (2021) investigated children interface with writing during the literacy cycle in a public school, in a vulnerable territory, in Sobral County, Ceará State. This author has concluded that

[...] a) children's relationship with writing is set by the basis of a school focused on learning how to write based on care with social interaction; b) children narratives point out their involvement

in reading practices linked to several textual genres; textual production; calligraphy using; copies; playful and interactive games; as well as to assignments related to external evaluation. [...] With respect to managerial and pedagogical practices, analyses have shown that school take the perspective of equity in learning, over the years, based on a) education actions that ensure children attendance in classroom; b) collective and individual attention based on school effort for children with learning issues; [...] d) permanent articulation between school and family; e) monitoring children learning through external evaluation. It was concluded that writing as language action sets intrinsic relationships with children's attention and creativity, which are related to the development of socio-emotional skills, such as persistence, self-esteem, self-confidence and interaction with the other, through school support. (ANJOS, 2018, p. 8).

Mamede (2011) observed PS classrooms in Fortaleza before PAIC arrival and showed a teaching process almost fully lacking written-texts production and didactic material, as well as limited use of time for assignments focused on learning. It is important highlighting that the classroom is the core locus to reach equity when knowledge distribution is taken into account. Vóvio, Ribeiro and Martinic (2020) analyzed the teaching-learning process in three PS classrooms of a school taken as equitable in a high vulnerability territory, in Fortaleza, 8 years after PAIC arrival. It was done by applying a standardized scale (Stallings); this study showed that teachers use their academic time well, more than the time observed in other Brazilian states and in other Latin American countries.

Vóvio, Ribeiro and Martinic (2020) also point out that teachers' assignments are mainly carried out with the aid of didactic books or school texts, and it contrasts results recorded before PAIC, by Mamede (2011). Students' learning improvement in the herein assessed school, as hypothesis, was associated by Vóvio, Ribeiro and Martinic (2020) with better use of time in the classroom. According to them, these results are consistent with PAIC's goals, such as ensuring longer teaching time, using texts in the classroom and generating the expected learning.

Lopes (2021) states that PAIC spreads out the belief about the relevance of associations among teachers' formation, structured didactic material (distributed by the Program) and teaching in classroom, in Ceará State. It had impact on school practices.

Mota (2018) assessed four 'pair'¹¹ schools and the influence of awarded schools (one of the strategies used by PAIC) on educational establishments and on their participants. She stated to have a double path of consequences: non-awarded schools recommended for PAIC and those demanding pedagogical support to improve their results after this support. However, according to her, awarding, classified as 'meritocratic component', "provides social prestige to the awarded schools, [it has] negative impact on school agents, mainly on students in the supported school, as reported by implementing agents" (MOTA, 2018, p. 7).

Based on research about PAIC, it is possible inferring that there are authors who highlight the negative outcomes of the Program's strategies and the ones who state a series of benefits for teaching municipal networks, when it comes to collaboration, closer interactions, teaching accountability and, as herein advocated, equity broadening.

11- PAIC counts on an awarding event that helps the awarded school to contribute to the non-awarded ones so that the awarded ones can support the non-awarded ones – they are the so-called pair school.

By highlighting equity broadening in high vulnerability territories, in Ceará State and in Fortaleza City, which is a situation opposite to what must be expected based on the literature (RIBEIRO; VOVIO, 2017), the present article points towards the relevance of developing further qualitative studies in Ceará State, mainly those including municipalities and schools facing different contexts. They must be based on classroom observation and on investigation about managerial and implementation processes, so that it can reinforce the understanding of the herein presented results.

Quantitative research associating equity, social vulnerability and educational inequality based on social groups, in several locations in the country, also encompass elementary school and high school data, and it would allow identifying other experiences linked to educational equity broadening. It would lead to cases suitable for qualitative studies whose results could reinforce inputs for educational policies' design and implementation.

If one has in mind the updates in research about education and social vulnerability in the territories, based on the two reference screenings carried out in Scielo, the relevance of pointing out the existence of social vulnerability indices in Brazil gets clear. They have led to advancements in knowledge, mainly if we observe the difficulties approached by researchers to assess this phenomenon in France, where there are synthetic indices that express socio-spatial inequality. It is also essential highlighting the beginning of the indices' production, which has operationalized the sense of equity and was explained by the present study and by others, before it (SOARES; DELGADO, 2021; WALTENBERG; SIMIELLI; SOARES, 2021). These studies open windows of opportunity for new sights over knowledge distribution in the country.

The present study shines light on academic research and centers that focus on the "education and social vulnerability in the territories" topic. Its results can favor the formulation and implementation of educational policies that start from different needs recorded for beneficiaries who live in different territories, avoid issues like those reported by Melo (2020), as well as reinforce the arguments by Gomes and Melo (2021), who advocate for the relevance of having public policies that take into consideration socio-spatial differences in their design and implementation. According to Pereira-Silva (2016), educational policies need to consider the impact of socioeconomic inequality overlap, which is a phenomenon typical of high social vulnerability territories, on students, teachers and school managers.

The reinforcement of discussions in Brazil about the interface between educational equity and social vulnerability in the territories allows elaborating guidelines focused on education secretariats and on schools that are located in segregated and vulnerable territories. Ceará State's experience, and documents filed at MEC, such as the ones mentioned by Melo (2021) for 'Brasil Carinhoso' case, as well as French documents, can contribute to the production of guidelines driven by the design and implementation of educational policies in vulnerable territories.

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