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Does Bullying Affect the School Performance of Brazilian Students? An Analysis Using Pisa 2015

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Abstract

The present study aims to analyze the impact of the different dimensions of bullying (physical, psychological and indirect) on the school performance of Brazilian students. For this analysis, data from the Programme for International Student Assessment (PISA) from the year of 2015 were used. The methodology applied was the Propensity Score Matching (PSM), the Inverse Probability-Weighted Regression-Adjustment (IPWRA) and the categorical multivalued treatment known as Generalized Propensity Score (GPS). The results show that physical bullying (being spanked and having belongings destroyed) is harmful for the students' academic performance. Psychological bullying (having gossip spread, being made fun of, and being threatened), however, did not negatively impact the grades. When considering the frequency (weekly, monthly, or annual) of bullying in the model, it is observed that, among the different dimensions of aggression, the effect on the grades of Brazilian students is both increasing and negative. Bullying causes several consequences to students in addition to the decrease of school performance since it can result in school evasion and sometimes difficulties in the labor market. Thus, studying this phenomenon, by means of school behavior, is an important subject for the society.

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Resumo
O presente trabalho tem como objetivo analisar o impacto das diferentes dimensões do bullying (físico, psicológico e indireto) no desempenho escolar dos alunos brasileiros. Para essa análise foram utilizados os dados do Programa Internacional de Avaliação de Estudantes (PISA) do ano de 2015. A metodologia empregada foi o Propensity Score Matching (PSM), o Inverse Probability-Weighted Regression-Adjustment (IPWRA) e o tratamento multivalorado categórico, Generalized Propensity Score (GPS). Os resultados mostraram que o bullying físico (apanhar e ter pertences destruídos) é prejudicial para o desempenho escolar dos alunos. O bullying psicológico (ter boatos espalhados, fizeram piadas e foi ameaçado), paradoxalmente, não afetou negativamente a nota dos estudantes. Ao considerar a frequência (semanal, mensal ou anual) das agressões no modelo, observa-se que, o efeito do bullying na maioria das dimensões é crescente e negativo nas notas dos estudantes brasileiros. O bullying traz diversas consequências para o estudante além da redução no desempenho escolar, pois, pode acarretar abandono escolar e por vezes dificuldades no mercado de trabalho. Portanto, estudar esse fenômeno, por meio do comportamento escolar, é um assunto de importância para a sociedade.

Keywords Bullying · School performance · Aggression · Pisa · Microeconometrics

Palavras-chaves Bullying · Desempenho escolar · Agressão · Pisa · Microeconometria

1 Introduction

Bullying is defined as the conscious and deliberate desire of abusing another person and to put them under tension (Fante 2005).[1] A student is being intimidated or victimized when he or she is repeatedly exposed to negative actions by one or more students, in a context of uneven power or force (Olweus 1993). To be a bully implies in being involved with repeated and intentional negative behaviors with an individual or with a group of people who have difficulty to defend themselves (Olweus 1997). Bullying may be of different types such as physical, verbal, social or electronic (cyberbullying) (Olweus 1993).

Studies on school violence are recent, the first ones dating from the 80's (Eyng et al. 2009). The theme is awakening the attention of society, families, and educators. Violence in schools is a complex phenomenon affecting the daily life of students, threatening their physical and psychological integrities, in addition to their human dignity (Eyng et al. 2009). As from the 90's, there has been an increase in interpersonal violence among students, which is usually expressed through verbal aggressions (Leme 2009).

[1] According to the Brazilian Multi-professional Association of Protection to Childhood and Adolescence (ABRAPIA) as there is no word in Portuguese that represents all situations of bullying, the actions that may be present in this practice are: putting nicknames, offending, mocking, enjoying, incarnating, messing with, humiliating, making suffer, discriminating, excluding, isolating, ignoring, intimidating, stalking, harassing, terrorizing, frightening, bullying, dominating, aggressing, beating, shooting, pushing, harming, stealing/breaking belongings.

Bullying is one of the most frequent types of violence in schools (Batsche 1997). Its practiced in childhood and is associated with externalization problems, such as aggressive and anti-social behavior in adulthood, while victimization is associated with internalization problems such as depression and anxiety (Kaltiala-heino et al. 2000; Sourander et al. 2000). Regarding behavior, the effects of being bullied may be confused among the different effects associated to being a bully, being a passive victim and being a bully victim (Georgiou and Stavrinides 2008).

Bullying affects individuals in both cognitive and psychological levels. Children involved in bullying have increased behavioral problems, hyper-activity and misconduct, when compared to students not involved with this practice (WOLKE et al. 2000). Lopes (2005) indicated that children who are bullied have a low self-esteem, aggressive and provocative behaviors, and possible psychological alterations, requiring special attention. Furthermore, they can become depressed, anxious, insecure, and inopportune children, trying to humiliate their colleagues to cover up their own limitations. According to Bradshaw (2015), being a victim of bullying represents a major impact on life satisfaction.

Bullying is nothing more than a way of expressing prejudice and intolerance to social, personal, and structural situations that are different from the standard idealized by the consumer society (Bacila 2005). Thus, its occurrence is related to actions of hostility and stigmatization when the victim has, as stated by Bacila (2005), socially represented characteristics as negative or inferior, which generates a prejudice.

The negative connection between school performance and bullying may be explained by the fact that the victim has a lower school attendance, less contact with their colleagues and a greater incidence of depression (Van Der Werf 2014). According to the author, the victims learn less since they have less interest in studying. Berthold and Hoover (2001) state that children who are bullied experience lower school attendance due to fear of going to school, as they have already suffered violence in that environment. Consequently, this increases the chances of possible evasions. This opinion is corroborated by Van der Werf (2014) who points out that these children learn less compared to their peers, since the school is a hostile environment. Wolke et al. (2013) found results similar to those of Berthold and Hoover (2001) and Van der Werf (2014), moreover the authors highlight the existence of greater chances for the occurrence of poor performance at work.

The school environment is the result of interactions between students and teachers. Therefore, bullying causes a change in this environment, affecting student involvement (Forster et al. 2019), contributing to transform the school into an uncomfortable and confrontational space (Pigozi and Machado 2015). Additionally, the rejection by peers in childhood and adolescence increases the risk of misconduct and decreases participation and interest in school, increasing the likelihood of dropping out (French and Conrad 2001).

The aim of this study is to analyze the impacts of bullying on the school performance of adolescents, and also to evaluate whether the effect differs considering the frequency (weekly, monthly or annual) which the student was bullied. This phenomenon will be analyzed according to the six questions elaborated in the questionnaire of the Programme for International Student Assessment (PISA) disclosed in 2015 by the Organization for Economic Co-operation and Development (OECD). In addition to presenting the grades of Brazilian students, it approaches the cognitive scope of the

child, through which it is possible to observe whether the student declared to have been bullied through the answers of the questionnaire.

In Brazil, the number of students who claim to have been a victim of bullying is the highest among other Latin American countries (Chile, Colombia, Uruguay and Peru) according to data of PISA 2015. Studies show that bullying is associated with low academic performance (Nansel et al. 2003) and a negative school environment (Låftman et al. 2017; Guerra et al. 2001; Olweus 1993).

Moreover, a high percentage of Brazilian students - compared to other countries - reported being bullied, as well as feeling like intruders in the school environment (OCDE 2017). Delprato et al. (2017) state that Brazil is one of the fifteen countries in Latin America in which children who have suffered psychological bullying are more likely to present a lower degree of socialization.

The use of PISA is justified through studies pointing out that bullying usually occurs between the ages of nine and fifteen years, which is the age period in which this research takes place (Carney and Merrell 2001). The dimensions investigated will be: being spanked, having gossip spread about them, having their belongings destroyed, being threatened, being made fun of and being left out. Bullying was divided into three categories: physical (being spanked, having their belongings destroyed), psychological (having gossip spread about them, being made fun of, being threatened) and indirect (being left out) as proposed by Olweus (1991). Thus, it will be possible to analyze which type of aggression affects more the students' school performance.

The estimation strategy will be carried out to compare students who have been bullied (treatment group) with those who have not been bullied (control group) according to certain observable characteristics. To verify the effect on the average, the methodology applied is the Propensity Score Matching (PSM). The Inverse Probability-Weighted Regression-Adjustment (IPWRA) is used to verify that the estimated effect of bullying on school performance is sensitive to the adjusted regression model, weighted by the inverse of the propensity score. Finally, the categorical multivalued treatment known as Generalized Propensity Score (GPS), will be applied to consider the different levels of exposure or intensity of victims to bullying, which may be different among the results obtained. In the present study, the indicator of multiple treatments was the frequency (weekly, monthly and daily) which the student was bullied.

The contribution of the present study is to analyze the connection between bullying and school performance in Brazil. Although there are texts on this theme, to the best of our knowledge there are no studies that have used the PISA database to verify the several dimensions related to bullying that affect school performance. The use of this database, which is nationally representative, differs from the one used by Oliveira et al. (2018) whose analysis was carried out in Recife, Brazil. Besides, it allows to investigate a transition period from elementary to high school, since the students are between 15 and 16 years old, which represents a especially sensitive period as many students evade school in this stage due to incentives to enter the labor market which make the student disregard the potential future gains from staying in school (Stearns and Glennie 2006). The investigation of these factors allows the development of more assertive policies for mitigating such issue.

This study is divided into six sections besides this introduction. Next, a literature review about the impact of bullying on school performance of children is presented.

Subsequently, the database, descriptive statistics and the empirical strategy are approached. Finally, the results are discussed, and the final considerations are elaborated.

2 Literature Review

2.1 Factors Associated with Bullying

Rigby and Slee (1991) found that younger children are more prone to suffer bullying than older ones. In addition, bullying usually happens between nine and fifteen years because it is the period in which victims have characteristics that weaken them before the aggressor (Carney and Merrell 2001). Nevertheless, bullying tends to stop with increasing age as people acquire social skills which improve their self-esteem (Smith et al. 1999).

Children practicing bullying reported that their parents did not exercise functions of care and monitoring, sometimes even being negligent (Bowers et al. 1992), which is contrary to victims of bullying who have a strong relationship with their parents and are therefore overprotected. Finnegan et al. (1998) reported similar results, where bullies had relations of lower cohesion with their families, while victims were too closely linked to their relatives. The family environment and the relationships established therein can favor aggressive behaviors (Blaya 2002; Neto 2005; Farrington 2002; Eriksen et al. 2014). Tortorelli et al. (2010) pointed out a positive association between bullying and the family environment being violent or not very affective.

According to Pigozi and Machado (2015), there is a high prevalence of bullying among Brazilian adolescents. Additionally, there is a strong connection between bullying and risky behavior, including the use of illicit drugs, use of alcohol, fights, and truancy. And yet, the emotional and psychological consequences of bullying that arise during adolescence extend throughout adulthood.

There is a negative relationship between the educational level of the mother and being a victim of bullying (Silva et al. 2018). According to the authors, mothers with higher educational levels are able to impose limits, supervise and help children when they have difficulties to relate in school. The authors also found that victims of bullying feel more alone, have less friends and have insomnia, characteristics of depressive symptoms. Victimization generates depressive symptoms in children which damage their concentration, reducing motivation for schoolwork (Schwartz et al. 2005). Mello et al. (2016) also found that victims present greater depressive symptoms and high levels of suicidal ideation compared to non-victims. Victimization generates depressive symptoms in children which damage their concentration, reducing motivation for schoolwork (Schwartz et al. 2005).

Fu et al. (2013) indicated that students from families with a lower socioeconomic status are more likely to be victims of more severe types of bullying since schooling is an entangled indicator of social stratification. Nonetheless, parental lower levels of education is a factor associated with higher levels of bullying exposure. The authors also pointed out that children of single parents are more prone to be involved in bullying, both as victims and aggressors.

2.2 Bullying and School Performance

Costa and Pereira (2010) found that students who presented school failure were more involved in episodes of bullying. Besides, this result corroborates the theory that the greater the failure, the more aggressive the children are. In addition, victimization causes a lower school performance during the period in which the child is being victimized, as identified by Carvalhosa et al. (2009).

The greater the contact of the child with the school, the smaller his association with violence (Resnick et al. 1997). The low levels of intelligence and poor progress in school emerge as risk factors associated with violence between children and youngsters. Children with low school performance rise as targets of bullying (Schwartz et al. 2002). Fu et al. (2013) pointed out that students with low academic performance have a higher risk of being bullied at school and may be negatively impacted by being victims of bullying (Contreras et al. 2016). Paradoxically, being a victim has positive effects on students with a higher school achievement when compared to the other levels of performances. The results found by the authors suggest that there may be a heterogeneous connection between school performance and suffering/practicing bullying, depending on student's skills.

Eriksen et al. (2014) identified that children who were victims of this practice had lower grades and these effects have a tendency of increasing according to the severity of the act. Ponzo (2013) also found a negative correlation between bullying and academic performance, that is, being bullied reduces the grades of Italian students. Bullying has several consequences for students such as lack of interest in school, low academic performance and impairment in social relationships (Blaya 2002; Neto 2005; Fante 2005). Most victims do not react or speak about the aggression suffered (Neto 2005). And since these acts occur outside the sight of an adult, it is possible to understand why parents and teachers underestimate the prevalence of bullying and end up not acting to stop this situation. Oliveira et al. (2018) point out that socio-emotional skills can help students deal with bullying. Thus, the authors conclude that programs to combat this practice should assess non-cognitive skills.

Studies have indicated that the psychological pain caused by the victimization of colleagues impairs school motivation and performance (Buhs et al. 2006; Juvonen et al. 2000; Schwartz et al. 2005). Victimization generates depressive symptoms in children which damage their concentration, reducing motivation for schoolwork (Schwartz et al. 2005). Thus, victimized students present a lower academic performance because they become less engaged in school, reducing both participation in the classroom and school attendance (Cornell et al. 2013).

According to a study made by The Institute of Economic Research Foundation (FIPE 2009)[2] in 501 public Brazilian schools in 2009, bullying has a significant correlation with the averages of the "Prova Brasil". Those correlations are negative, thus, in schools where there is a higher occurrence of bullying, the averages in this test are lower. A consistency is observed in the international and national literature since most of the studies find that bullying negatively impacts the school performance.

[2] Available in: http://portal.mec.gov.br/dmdocuments/relatoriofinal.pdf

3 Methodology and Database

3.1 Database

The Programme for International Student Assessment (PISA) is an international exam that measures the educational level of 15-year-olds through tests of Reading, Mathematics and Sciences. This age is employed for the exam because it is presupposed as the end of compulsory basic schooling in most countries. PISA is held every three years by the Organization for Economic Co-operation and Development (OECD) – which is formed by 30 countries that have as principles democracy and a market economy. Countries that are not part of OECD can also take part in the exam, which is the case of Brazil. The National Institute for Educational Studies and Research "Anísio Teixeira" (INEP) is responsible for carrying out the Program's tests in the country.

PISA has the objective of producing indicators that contribute to the discussion of the quality of basic education and that may assist national education improvement policies. Besides, through the tests the program aims to identify not only how the student reproduces knowledge but his ability to use this knowledge inside and outside the school context.

A knowledge area is highlighted every year in which PISA is carried out, in other words, most of the questions are directed towards this area. In 2015 the area emphasized was Sciences. The program is among the most recognized global evaluations of education. In Brazil, the National Plan of Education (NPE), Law number 13,005 in its seventh goal highlights the strategy of improving the school performance of students in Basic Education, in order to reach the averages observed every year in schools in OECD member countries.

PISA is applied through a sample in which the records of the schools in each participating country are used in the data selection process. In the case of Brazil, the data used are from the School Census. The organization of PISA establishes that it is necessary for each country to have at least 150 schools participating in the test. Since 2006 Brazil has been increasing its sample, and in the year of 2015, there were a total of 841 participating schools, 23,141 students and 8287 teachers participating. Therefore, the size of the sample may ensure a greater reliability of the representativeness of the results reached in Brazil.

By means of PISA 2015, it is possible to identify youngsters who have suffered or not been bullied at school in the last twelve months from the following statements answered by the students: i) "other students left me out on purpose", ii) "other students made fun of me", iii) "I was threatened by other students", iv) "other students removed or destroyed my belongings", v) "I was spanked or pushed by other students" and vi) "others students spread gossip about me". The students could answer with the following options: "never or almost never", "sometimes during the year", "sometimes during the month" and "once per week or more". The construction of each aspect of bullying was made through dummies for each of the questions above, where the answer "never or almost never" configures that students did not suffer the type of threat mentioned, and the other options represented students who suffered it, according to the definition of PISA. The bullying variables were divided into three categories: physical (being spanked

and having their belongings destroyed), psychological (having gossip spread about them, being made fun of and being threatened) and indirect (other students leaving them out on purpose) as proposed by Olweus (1991) for a better specification.

In addition, dummies were created regarding the perception of the student within the school. In other words, if the student feels out of place, weird, alone or part of the school unity. Through these variables it will be possible to analyze if those students who have been bullied identify as strangers in the school environment when compared to those who have not been victims. The more students perceive the school as an unsafe place, the more they report to being victims of bullying (Matos and Gonçalves 2009). Forster et al. (2019) emphasize the importance of student engagement with the school as a tool to prevent episodes involving bullying. This situation would reduce, according to French and Conrad (2001), the chances of the students assuming aggressive behaviors, using illicit substances and, finally, school evasion.

Table 1 - Descriptive Statistics – dependent variables

Different Dimensions of Bullying			**Dependent Variables**		
			grade_mathematics Score obtained in the test of mathematics	grade_reading Score obtained in the test of reading	grade_sciences Score obtained in the test of sciences
spread_gossip	Control	Average	389.47	423.36	412.97
		(SD)	(85.37)	(92.55)	(84.25)
	Treatment	Average	399.43	427.76	418.67
		(SD)	(85.41)	(96.11)	(86.85)
Spanked	Control	Average	392.52	427.08	415.75
		(SD)	(85.37)	(92.17)	(84.38)
	Treatment	Average	375.77	382.9	390.12
		(SD)	(85.34)	(99.29)	(87.22)
belongings_destroyed	Control	Average	391.17	426.03	414.61
		(SD)	(84.8)	(92.29)	(84.2)
	Treatment	Average	393.56	410.08	410.03
		(SD)	(90.5)	(99.61)	(89.32)
Threatened	Control	Average	392.75	427.17	415.92
		(SD)	(85.61)	(92.45)	(84.67)
	Treatment	Average	378.64	395.46	396.31
		(SD)	(83.02)	(96.37)	(84.06)
made_fun of	Control	Average	388.61	423.35	411.83
		(SD)	(84.6)	(92.1)	(83.88)
	Treatment	Average	401.58	427.35	422.22
		(SD)	(87.56)	(97.34)	(87.56)
Left out	Control	Average	390.87	425.24	414.07
		(SD)	(85.27)	(92.57)	(84.48)
	Treatment	Average	393.8	420.1	414.2
		(SD)	(86.23)	(96.04)	(86.1)

Source: Self elaboration from data of PISA (2015). The standard deviation (SD) is reported in parentheses

Table 2 - Descriptive Statistics

Variables	Description	Did not suffered *bullying* Average (SD)	Suffered some kind of *bullying* Average (SD)
Independent	**Individual and Family Characteristics**		
Male	Child of male sex (0 = No, 1 = Yes)	0.45 (0.5)	0.5 (0.5)
scholarity_father	Schooling level of the father measured from 1 to 5 where each number corresponds to a level of schooling[a]		
none	Schooling level of the father (0 = No, 1 = Yes)	0.1 (0.3)	0.096 (0.29)
ISCED 1	Schooling level of the father (0 = No, 1 = Yes)	0.2 (0.4)	0.17 (0.37)
ISCED 2	Schooling level of the father (0 = No, 1 = Yes)	0.18 (0.39)	0.19 (0.39)
ISCED 3B, C	Schooling level of the father (0 = No, 1 = Yes)	0.02 (0.15)	0.2 (0.14)
ISCED 3A, ISCED 4	Schooling level of the father (0 = No, 1 = Yes)	0.31 (0.46)	0.3 (0.46)
ISCED 5B	Schooling level of the father (0 = No, 1 = Yes)	0.03 (0.17)	0.04 (0.2)
ISCED 5A, 6	Schooling level of the father (0 = No, 1 = Yes)	0.15 (0.36)	0.18 (0.38)
scholarity_mother	Schooling level of the mother measured from 1 to 5 where each number corresponds to a level of schooling		
none	Schooling level of the mother (0 = No, 1 = Yes)	0.07 (0.25)	0.06 (0.25)
ISCED 1	Schooling level of the mother (0 = No, 1 = Yes)	0.17 (0.38)	0.14 (0.35)
ISCED 2	Schooling level of the mother (0 = No, 1 = Yes)	0.19 (0.4)	0.19 (0.4)
ISCED 3B, C	Schooling level of the mother (0 = No, 1 = Yes)	0.02 (0.15)	0.02 (0.13)
ISCED 3A, ISCED 4	Schooling level of the mother (0 = No, 1 = Yes)	0.32 (0.47)	0.33 (0.47)
ISCED 5B	Schooling level of the mother (0 = No, 1 = Yes)	0.02 (0.16)	0.03 (0.17)
ISCED 5A, 6	Schooling level of the mother (0 = No, 1 = Yes)	0.02 (0.16)	0.03 (0.16)
assets_home	Assets of the house	−1.28 (1.06)	−1.2 (1.07)
assets_cultural	Cultural assets of the house	−0.37 (0.79)	−0.32 (0.8)
assets_family	Wealth of the family	−1.17 (1.05)	−1.09 (1.05)
grade_repetition	Child repeated grade (0 = No, 1 = Yes)	0.28	0.29

Table 2 (continued)

Variables	Description	Did not suffered *bullying* Average (SD)	Suffered some kind of *bullying* Average (SD)
		(0.45)	(0.46)
Age	Age of the child in years	15.88 (0.28)	15.88 (0.28)
like_me	Child has the perception of other studentsliking them (0 = No, 1 = Yes)	0.78 (0.41)	0.75 (0.43)
feel_dislocated	Child feels dislocated at school (0 = No, 1 = Yes)	0.13 (0.34)	0.22 (0.41)
feel_belongging	Child feels part of the school (0 = No, 1 = Yes)	0.73 (0.44)	0.72 (0.45)
friendship_easy	Child makes friendship easy (0 = No, 1 = Yes)	0.70 (0.46)	0.69 (0.46)
feel_weird	Child feels weird at school (0 = No, 1 = Yes)	0.15 (0.35)	0.25 (0.43)
feel_alone	Child feels alone at school (0 = No, 1 = Yes)	0.14 (0.35)	0.23 (0.42)
Independent	**School Characteristics**		
Private	Child studies in the private network (0 = No, 1 = Yes)	0.14 (0.35)	0.18 (0.38)
size_class	Total number of students at the class of the child	36.22 (8)	35.88 (8.07)
number_teachers	Total number of teachers at the school	34.72 (20.84)	34.81 (20.91)
number_girls	Number of girls divided by the size of the class	13.23 (7.23)	13.03 (7.3)
number_boys	Number of boys divided by the size of the class	12.28 (6.78)	12.04 (6.86)
Independent	**Different Dimensions of Bullying**		
spread_gossip	Child had gossip spread at school (0 = No, 1 = Yes)	0	0.51 (0.5)
Spanked	Child was spanked at school (0 = No, 1 = Yes)	0	0.17 (0.37)
belongings_destroyed	Child had their belongings destroyed at school (0 = No, 1 = Yes)	0	0.29 (0.45)
Threatened	Child was threatened at school (0 = No, 1 = Yes)	0	0.24 (0.43)
made_fun of	Child was made fun of (0 = No, 1 = Yes)	0	0.56 (0.5)
left_out	Child feels left out by colleagues at school (0 = No, 1 = Yes)	0	0.51 (0.5)
N (number of obs)		6693	4230

Source: Self elaboration from data of PISA (2015)

[a] Both for the father's schooling and for the mother's schooling, the educational levels are as follows:0 – none; 1 – ISCED 1; 2 – ISCED 2; 3 – ISCED 3B, C; 4 – ISCED 3A, ISCED 4; 5 – ISCED 5B; 6 – ISCED 5A,6

The average grades of students who have been bullied, with no differentiation by the type of aggression, are outlined in Table 1 above, and are higher compared to those students who were not bullied. However, when analyzing by the type of bullying endured, it appears that students who reported having been spanked or threatened (which constitutes physical bullying) present lower grades. Moreover, students who have had their belongings destroyed or who have been left out also scored lower, except for mathematics.

However, students who reported that they had gossip spread about them and that their colleagues made fun of them (psychological bullying) presented, on average, higher grades than their peers who did not report this type of violence.

Table 2 shows the average and standard deviation of the variables for students divided in two groups: a control group – students who did not suffer any of the dimensions of bullying – and a treatment group – students who endured at least one of the dimensions of bullying. Besides, it presents the six dimensions of bullying studied. Students who suffered bullying represent 38.73% of the sample. It is worth to highlight that only observations that had no missings in any variable were kept. Therefore, the final number of observations of the sample was 10,923.

Adolescence is characterized as the period with the highest occurrence of bullying (Kenny et al. 2005; Moon et al. 2016). The moment in which the highest incidence of bullying episodes and school violence occurs is between the ages of nine and fifteen and it decreases as the age increases (Hazler 1996; DUE et al. 2005; Beaty and Alexeyev 2008). The average student age is between 15 and 16 years.

It is possible that there is an age-grade distortion, since PISA is applied to children of 15 years old that are enrolled from the 7th grade of elementary school until the third year of high school. The cut of age occurs because the end of compulsory schooling in Brazil is assumed. According to Harris et al. (2019), students who have repeated a grade are more likely to be bullied in schools where retention is not common, and high academic achievement is expected such as in private schools in Brazil. The authors emphasize that repeating a grade is a normal event, both once and several times, in public and private schools in Brazil.

Regarding individual and family characteristics, students who have been bullied have higher educated parents, and are mainly enrolled in private schools. As for the variables concerning the perception of the student within the school, the students who have been bullied are the ones who feel the most displaced, alone and strange, according to the existing literature (OCDE 2017; Berthold and Hoover 2001; Van Der Werf 2014). However, those who have not endured it are the ones who make friends more easily, feel that they belong to the group and feel that their colleagues like them.

Variables representing the socioeconomic status of the family – "assets_home", "assets_cultural" and "assets_family" – were higher for students who were bullied. It is worth to stress that these variables were created by PISA through the item response theory and the negative sign represents that the Brazilian average is below the average of OECD countries.

To eliminate the outliers of the sample, the size of certain variables was limited. Schools that had no teachers, and those declaring to have 120 or more teachers in their staff were removed from the sample. This strategy was made by observing the frequency table, whose accumulated percentage corresponded to 99.13% of the sample.

The cutting number was thus defined, since the frequency was small and less relevant above this percentage. The same happened with the variables "number_girls" – which was limited to school unities having 1282 girl students or more - and "number_boys" – which was limited to schools with 1195 boy students or more.

3.2 Methodology

3.2.1 Propensity Score Matching

By means of the PISA questionnaire, adolescents can answer with what frequency, during the last twelve months, they have endured practices related to bullying. Therefore, the proposed identification strategy is to compare those students who answered that they have never been bullied with the victims who have.

To estimate the effect of the several dimensions of bullying on student's grades, the method of Propensity Score Matching (PSM) was employed. The methodology was developed by Rosenbaum and Rubin (1983) and aims to analyze the probability of a group receiving the treatment, taking into consideration several observable characteristics, X, in common between the two groups. Thus, it is assumed that each member of the treatment group (student who have suffered some of the dimensions related to bullying) has a pair in the control group (student who have not suffered it). To avoid the problem of dimensionality, the vector X of observable characteristics was replaced by p(X), which is defined as the score of propensity

$$P(X) = Pr(T = 1|X) \tag{1}$$

Being valid the hypothesis of selection in the observable, the independence between the potential result in the absence of treatment and the decision of participating or not will also be valid. Thus,

$$Y_i(0) \perp T_i|X \Rightarrow Y_i(0) \perp T_i|p(X_i) \tag{2}$$

Where Y_i is the variable to be explained (school performance of students in Sciences, Mathematics and Reading), T_i is the treatment (suffering bullying) and X_i is the vector of explanatory variables. Thus, it is possible to estimate the average effect of the treatment over the treated making the pairing between individuals who suffered each one of the dimensions of bullying and those who did not suffer it based only on the propensity score. However, for estimating the propensity score it is necessary to apply a logit or probit model, since it is unknown. In the case of the present study, the logit model will be used:

$$\Pr(T = 1|X = x) = \frac{\exp(x\beta)}{1 + \exp(x\beta)} \tag{3}$$

Where β is the vector of parameters that will be estimated in a first stage. Being $\widehat{\beta}$ the estimator of β, then the score of propensity is estimated as:

$$\widehat{p}(x) = \frac{\exp\left(x\widehat{\beta}\right)}{1 + \exp\left(x\widehat{\beta}\right)} \tag{4}$$

Pairing by the nearest neighbor is one of the most commonly used estimators for defining the proximity of the propensity score of individuals who suffered some of the types of bullying regarding the propensity score of those individuals who did not suffer it. This estimator uses results of the N individuals in the group not treated (which were not bullied) having propensity scores closer to that of the individual *i* who suffered some of the types of bullying, in order to estimate what would be the result of this individual *i* if they had been bullied. Besides, in this study the method of closer neighbor with replacement was applied because the counterfactual may be paired with different treated observations. The advantage of using this method is that the quality of the pairing increases, as well as the bias is reduced (Caliendo and Kopeinig 2008).

Being H_N the set of the M observations with a lower value of $|\widehat{p}(X_j) - \widehat{p}(X_i)|$, it is possible to build the sample analogue for the potential result of the individual if they were not treated (did not suffer bullying):

$$\widehat{Y}_i(0) = \frac{1}{M} \sum j \epsilon H_M(i) Y_j \tag{5}$$

The Average Treatment Effect on the Treated (ATT) ones, when the Hypothesis of Conditional Independence (HCI) is supposed, is $E[Y_{1i} - Y_{0i} \mid X_i]$. Supposing HCI, the resulting ATT from the direct pairing of the values of propensity between treated and not treated, applying the law of iterated expectation on X_i, is:

$$\begin{aligned} ATT &= E[Y_{1i} - Y_{0i} \mid T_i = 1] \\ &= E\left\{ E\left[Y_i \middle| P(X_i), T_i = 1 \right] - E[P(X_i), T_i = 0] \middle| T_i = 1 \right\} \end{aligned} \tag{6}$$

Where Y_{1i} is the potential results of the individual *i* when he participates in the treatment ($T_i = 1$) and Y_{0i} is the potential results of the individual *i* when he does not participates ($T_i = 0$).

The typical estimator of the pairing by propensity score is described below:

$$ATT_{PSM} = \frac{1}{N_T} \left[\sum_{i \in T} Y_{1,i} - \sum_{j \in C} \omega(i,j) Y_{0,j} \right] \tag{7}$$

Where N_T is the number of treated individuals belonging to the region of common support and $\omega(i,j)$ is the scheme of weight used to aggregate the potential result of individuals from the control group and depends on the propensity score of the participant i, $P(X_i)$, and of the propensity score of the non-participant j, $P(X_j)$.

3.2.2 Inverse Probability-Weighted Regression-Adjustment (IPWRA)

The Inverse Probability-Weighted Regression-Adjustment (IPWRA) - known as one of Wooldridge's (2007) doubly robust estimators - is performed in three stages and uses the inverse of the probability of having been bullied to estimate the adjusted regression coefficient. First, the model parameters are estimated, and the propensity score is calculated; subsequently, the inverse probability weighting is used and adjusted to the regression models. Finally, the grades are averaged for students who have been bullied to provide the ATT.

The IPWRA estimator allows the analysis of several treatments at the same time, which is an advantage over the PSM estimator, by specifying a multinomial logit model for the treatment, and combining regression adjustment and probability weighting to provide robustness to the incorrect specifications of the parametric models. The IPWRA verifies whether the estimated effect of being bullied on school performance is sensitive to the adjusted regression model weighted by the inverse of the propensity score. Through this test it is possible to remove the influence associated with the fact that the student is observed in only one of the situations of being or not being bullied (treated or untreated), mitigating the fact that there is insufficient information. In addition, as demonstrated by Imbens and Wooldridge (2009), the combination of weighting with regression aims to circumvent the problem of poor specification, whether it is derived from the regression model or the propensity score equation.

3.2.3 Multivalued Treatments, Generalized Propensity Score (GPS)

The dose of a treatment may not be homogeneous among all treated. In the case of this article, students may have been bullied a few times a year, sometimes a month or a few days a week. Therefore, the treatment group is subject to different measures of bullying frequency, however, the control group is composed of students who have not suffered this type of violence at all. In addition, in multivalued situations it is not necessary to divide the sample of individuals into subpopulations as it is done for propensity score matching (PSM), however it is sufficient that the base is divided into subpopulations through which the average potential products can be estimated (Imbens and Wooldridge 2009). According to Wooldridge's (2010) notation, the treatment variable (w_i) can assume different G + 1 values, so that {0, 1, 2, ..., G}, with zero being the control group and 1, ..., G the different levels of treatment. So, there are G + 1 counterfactual results that are denoted for a random sample, i, $\{y_{ig} : g = 0, 1, \ldots, G\}$. The results, y_i, can be described as follows:

$$y_i = 1[w_i = 0]y_{i0} + 1[w_i = 1]y_{i1} + \ldots + 1[w_i = G]y_{iG} \tag{8}$$

Determining that $\mu_g = E(y_{ig})$ is the population average of the counterfactuals and using a vector of covariates x_i, a condition of sufficient ignorability to identify the means is the

assumption of conditional independence:

$$E\left(y_{ig}|w_i,x_i\right) = E\left(y_{ig}|x_i\right) \quad ,\mathrm{g} = 0,1,\ldots,\mathrm{G} \tag{9}$$

Through this equation we have:

$$\begin{aligned} E\left(y_{ig}|w_i,x_i\right) &= 1[w_i = 0]E(y_{i0}|x_i) + 1[w_i = 1]E(y_{i1}|x_i) + \ldots \\ &+ 1[w_i = G]E(y_{iG}|x_i) \end{aligned} \tag{10}$$

Demonstrating that the function of averages $E(y_g|\,x)$ is identified provided that:

$$E\left(y_g|x\right) = E(y|w = g,x) \tag{11}$$

Thus, it is possible to estimate $E(y|\,w = g,x)$ for each given a random sample where attention is restricted to units where $w_i = g$. This adjustment can be done through regressions, making the multivalued situation an extension of the case where w_i is binary.

Given the estimates for the conditional average $\left\{\widehat{m}_g(x) : g = 0,1,\ldots,G\right\}$ ATT is estimated for treatment level (h) relative to level(g), as:

$$\widehat{\tau}^{ATT}_{gh,reg} = N^{-1}\sum_{i=1}^{N}\left[\widehat{m}_h(x_i) - \widehat{m}_g(x_i)\right] \tag{12}$$

Therefore, if $\widehat{\tau}^{ATT}_{gh,reg}$ is the ATT for those in groups g or h, $\widehat{\tau}^{ATT}_{gh,reg}$ will be obtained from the mean differences $\widehat{m}_h(x_i) - \widehat{m}_g(x_i)$ within the subsample with $w_i = g$ and $w_i = h$. For this, the overlap hypothesis is essential, given the need to rely on observations with a positive probability of designation at all levels of treatment.

Thus, to estimate the causal effect of discrete multivalued treatments, the following predictive models were used: i) result variable (adjustment by RA regression of the Poisson type given the non-negative nature of school grades); ii) the treatment designation variable (estimators based on inverse probability weighting - IPW), obtained using a multinomial logit). Furthermore, doubly robust estimators were tested, associating the benefits of each of the previous approaches (IPWRA) according to the approach proposed by Hirano and Imbens (2001), Wooldridge (2010).

Treatment values were defined based on PISA responses, as follows:

Dose = 0 (children who declared that they were not bullied);
Dose = A (children who reported being bullied a few times a year);
Dose = B (children who reported being bullied a few times a month);
Dose = C (children who reported being bullied once a week or more);

3.2.4 Rosenbaum Tests

Certain factors that are not observed in the estimation may skew the results of the effect of the treatment over the treated ones. Thus, the bounds analysis measures the potential impact of the selection bias that arises due to the non-observed variables. In this study, the method known as Rosenbaum Bounds (Rosenbaum 2002) was applied. The purpose of the test is to estimate what should be the influence of an eventual variable omitted over the existing selection bias on the probability of participation in the treatment, and that may eventually undermine the conclusions regarding the causal effects.

This sensitivity analysis may be used to test the robustness of the results to the presence of an omitted co-variable. In this study, the test aims to evaluate the impact of an eventual omitted variable on the grades of students. Considering that the probability of child's i participation in the program is given by:

$$\theta_i = P[(T = 1)|x_i] = F(\beta x_i + \gamma u_i) \tag{13}$$

Where x_i are the observable characteristics of the child, T is equal to 1 if the child receive the treatment and 0 if he does not; u_i corresponds to the variable not observed; γ represents the u_i effect on the decision to participate in the treatment. If there is no selection bias, then γ is equal to 0 and the probability of being bullied will be determined exclusively by the observable characteristics. However, in the presence of selection bias, two children with the same covariates observed, x, will have different chances of being bullied.

The method identifies two individuals with observable characteristics, called i and j, within a logistic distribution. The relative probability (odds) of children receiving treatment is given by:

$$\frac{\theta_i}{(1-\theta_i)} = \frac{\theta_j}{(1-\theta_j)} \tag{14}$$

The Rosenbaum Bounds may be expressed by the equality:

$$\frac{1}{e^{\gamma}} \leq \frac{\theta_i(1-\theta_j)}{\theta_j(1-\theta_i)} \leq e^{\gamma} \tag{15}$$

Where γ expresses the measurement of the rupture degree of a sample free from the selection bias. Thus, when $\gamma = 0$, the degree of association will be equal to one, implying the non-existence of a selection bias.

4 Results

4.1 Propensity Score Matching (PSM)

Table 6 (Appendix) presents the logit estimation for the probability of being bullied according to several dimensions (physical, psychological, and indirect), controlling by

means of observable characteristics. Besides, in Fig. 1 it is possible to observe the density of the propensity score for the non-paired and paired samples for each one of the bullying dimensions. It is possible to remark that, after the pairing, the distributions are quite similar, since overlap is verified between the distributions of the treated and control groups. Table 3 below presents the results on student performance according to the different types of bullying, after estimating the propensity score considering the observable characteristics.[3]

Grade: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The results obtained through the propensity score methodology would be overestimated. However, the use of IPWRA confirms that the signs of the variables for both methodologies remain the same, regardless of the type of bullying investigated.

In addition, it is possible to observe that the subject with the greatest differences among grades is Reading. It is probable that students with Reading deficit are targets of bullying because this deficit may lead to rejection by the colleagues through bad interpretation of social situations by the affected students (Luciano and Savage 2007). Thus, students who have already had difficulties in Reading discipline, may have their performance worsened once they are targets of bullying, which would explain the high differentials of grades between the treatment and the control groups.

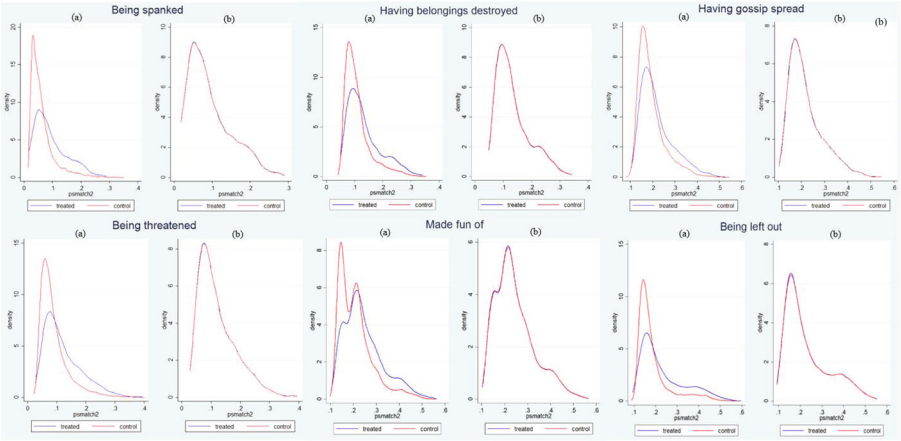
Bullying is associated with poor school performance. (Nansel et al. 2003; Fu et al. 2013). Among the aspects that compose physical bullying, suffering a physical aggression within the school environment causes a reduction in the average school performance of Brazilian students. The results corroborate the literature that points to a reduction in school performance caused by bullying (Ponzo 2013; Eriksen et al. 2014; Wolke et al. 2013). In addition, Brazil follows the same path of OECD countries, in which students with lower grades are more likely to report bullying exposure (OCDE 2017).

Students who were spanked had lower grades compared to their peers who did not suffer this type of violence. This student had his grade reduced in 13.33 and 20 points in the subjects of Mathematics, Reading and Sciences, respectively. This type of aggression is the easiest to identify by the victims among the ones analyzed in this study (OCDE 2017). The results also corroborate with the analysis made by Delprato et al. (2017) who found impacts on the math grades for physical bullying in Brazil. It should be noted that this is one of the bullying dimensions that is the easiest to identify.

Furthermore, students who had belongings destroyed had grades near ten times lower on the Reading test. However, no similar effect is verified for the other subjects. Students who are bullied tend to feel the school as a hostile environment and do not feel a part of it (Berthold and Hoover 2001; Van Der Werf 2014). According to Leme (2009), the threats at school are increasing. Among the aggressions that involve this type of bullying, being threatened is the clearest of them, so the student knowing that he is being threatened has a negative impact on his school performance.

The most common type of bullying is the psychological, that is, being called names, being insulted, being made fun of and having gossip spread about them (Bandeira and Hutz 2012; Pigozi and Machado 2015). This type of bullying may not be easily identified by the victims because, in Brazil, students see bullying as a joke or prank

[3] Other methods of pairing were tested and the results were similar. Those may be made available upon request to the authors.



Source: Self elaboration from data of PISA (2015)

Fig. 1 Distribution of sample before (a) and after pairing (b). Source: Self elaboration from data of PISA (2015)

made by their colleagues. This may explain the positive effects of this type of violence on students' grades in all subjects, except for having gossip spread about them, which was only significant for the math grade.

Bullying is the most reported by those students who are the youngest in the class (Ballatore et al. 2020). As the older ones in the class are generally the most perpetrators of bullying against younger ones, this may be one of the reasons why psychological bullying has a positive effect on the upper grade tails.

Regarding indirect bullying, we may find an identification problem by the victim. This type of bullying happens "behind the back" of the student which makes it more difficult to recognize, because the victim may not know the identity of the aggressor (Raimundo and Seixas 2009). The more difficult the identification, the harder it is to

Table 3 – PSM results

Variable	Math Grade	Math Grade IPWRA	Reading Grade	Reading Grade IPWRA	Sciences Grade	Science Grade IPWRA
Physical Bullying						
Being spanked	−13.02***	−7.7**	−33.77***	−25.4***	−20.82***	−14.5***
Having Belongings Destroyed	2.17	4.14*	−10.73***	−6.85***	−1.21	−1.18
Psychological Bullying						
Having Gossip Spread	5.51*	6.49***	1.99	4.86	1.72	3.28
Being Threatened	−12.42***	−8.13**	−21.09***	−15.3***	−15.94**	−11.2***
Made fun of	8.39***	10.05***	5.7*	7.22***	7.52***	8.69***
Indirect Bullying						
Being left out	2.1	4.02**	0.85	1.05	2.4	2.13

Source: Self Elaboration from data of PISA (2015)

tackle the problem, which may explain the non-significance of this variable in the students' grades.

Nevertheless, the aspect related to the victim feeling of being left out by their colleagues was not statistically significant for any of the analyzed subjects. Physical bullying is the most evident type of bullying in schools, with teachers taking this violence more seriously than psychological or relational bullying (OCDE 2017). Psychological bullying tends to be less tangible than other types. Forster et al. (2019) pointed out that strengthening the bonds between students and teachers is one of the strategies to reduce bullying and encourage improvement.

4.2 Robustness Analysis

According to the Rosenbaum tests – as presented in Table 4 - the results showed to be satisfactory, since they reinforce the non-existence of bias in possible non-observable characteristics that affect the result. When gamma approaches one, it may be an indicative of non-observable bias that may influence the result (Dehejia 2005). Thus, the distancing of one is a parameter that provides the result the reliability that the pairing adjusts to the observable characteristics and remains stable for the effects of the treatment.

Table 7 (Appendix) presents the robustness of the pairing. Through this Table it is possible to observe a reduction in Pseudo-R^2 as well as in the mean and median bias in the paired sample. Besides, both the Likelihood Ratio (LR) as well as the Pseudo-R^2 tests show that the statistical difference among the post-pairing groups no longer exists. It is worth to highlight that the *p* value becomes significant after the pairing, showing robustness in the results. Thus, these results indicate that the post-pairing groups are similar from a vector of observable variables.

4.3 Categorical Multivalued Treatment

Table 5 below outlines estimates and inferences that take into account the multiple levels of treatment, i.e. the frequency that the student has been bullied and their possible

Table 4 – Tests of Rosenbaum

Variable	Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
Grade Mathematics	1	0	0	389.63	389.63	388	391.27
	1.5	0	0	374.55	404.98	372.92	406.67
	2	0	0	364.13	415.88	362.48	417.63
Grade Reading	1	0	0	423.78	423.78	421.973	425.58
	1.5	0	0	406.93	440.7	405.1	442.54
	2	0	0	395.18	452.57	393.32	454.47
Grade Sciences	1	0	0	412.04	412.04	410.39	413.69
	1.5	0	0	396.82	427.58	395.19	429.28
	2	0	0	386.35	438.61	384.7	440.37

Source: Self Elaboration

Table 5 – Multivalued treatment results

Variable	Mathematics grade			Reading grade			Science grade		
	RA Poisson	IPW	IPWRA Poisson	RA Poisson	IPW	IPWRA Poisson	RA Poisson	IPW	IPWRA Poisson
Physical bullying									
Being spanked									
(A vs 0)	−5.5	−2.92	−5.5	−27.31***	−25.3***	−27.32***	−14.24***	−12.18***	−14.24***
(B vs 0)	−18.76***	−23.96***	−18.76***	−25***	−28.68***	−25***	−25.9***	−29.71***	−25.9***
(C vs 0)	−31.19***	−23.77**	−31.19***	−45.14***	−36.73***	−45.14***	−25.66***	−16.94	−25.66***
Having belongings destroyed									
(A vs 0)	8.43***	8.82***	8.43***	−7.17**	−7.68**	−7.17**	−0.3	−0.29	−0.3
(B vs 0)	−14.04***	−13.79***	−14.04***	−16.75***	−17.03***	−16.75***	−12.66**	−12.19**	−12.66**
(C vs 0)	−15.3***	−8.94***	−15.3***	−27.47***	−19.16***	−27.5***	−14.96***	−7.29	−14.96***
Psychological bullying									
Having gossips spread									
(A vs 0)	11.18***	11.46***	11.17***	5.82**	5.72**	5.82**	5.41***	5.47**	5.41***
(B vs 0)	−7.56*	−7.02*	−7.56*	−10.28**	−12.7***	−10.28**	−9.9**	−10.99**	−9.91**
(C vs 0)	−19.69***	−21.28***	−19.7***	−14.7***	−16.39***	−14.71***	−12.3***	−12.72***	−12.3***
Being threatened									
(A vs 0)	−4.48	−3.76	−4.48	−15.9***	−16.4***	−15.9***	−8.75***	−8.48***	−8.76***
(B vs 0)	−34.97***	−32.54***	−34.97***	−18.63**	−20.46**	−18.63**	−36.55***	−35.41***	−36.54***
(C vs 0)	−26.46***	−26.33**	−26.45***	−35.65***	−36.23***	−35.65***	−21.38***	19.76***	−21.38***
Being made fun of									
(A vs 0)	12.47***	12.61***	12.47***	4.83**	4.64**	4.83**	9.51***	9.40***	9.51***
(B vs 0)	−4.59	−5.2	−4.59	0.9	−2.12	0.9	1.29	0.65	1.29

Table 5 (continued)

Variable	Mathematics grade			Reading grade			Science grade		
	RA Poisson	IPW	IPWRA Poisson	RA Poisson	IPW	IPWRA Poisson	RA Poisson	IPW	IPWRA Poisson
(C vs 0)	−7.8**	−7.2*	−7.8***	−7.28	−9.7**	−7.28	−8.32**	−8.94**	−8.32**
Indirect bullying									
Being left out									
(A vs 0)	7.07***	7.32***	7.07***	2	1.74	2	4.68**	4.54**	4.68**
(B vs 0)	−9.60**	−9.68**	−9.6**	−12.42***	−13.4***	−12.42***	−7.37*	−7.7*	−7.37*
(C vs 0)	−25.86***	−26.09***	−25.86***	−28.92***	−32.01***	−28.92***	−29.28***	−30.68***	−29.28***

Source: Self Elaboration from data of PISA (2015)

Grade: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

impacts on school grades. The strategies used encompass the models for determining the outcome variables (school grades) by means of regression adjustment (RA) and, regarding the determination of the treatment propensity score, using the IPW techniques (weights by the inverse of the probability). In addition, the IPWRA method was applied to provide doubly robust estimators, as detailed in Hirano and Imbens (2001) and in Wooldridge (2010).

The results through the propensity score methodology could be biased since they do not consider the different frequencies of bullying. Thus, a model was estimated, with different specifications, to verify whether the frequency of bullying impacts the students' grades. According to Schwartz et al. (2002) frequent victimization by classmates is associated with poor academic performance in grades and performance tests.

Overall, the more frequent bullying, the greater the negative impact on the grade. Being bullied once a week has a negative impact on student performance, except for being threatened in the IPW model. While being bullied once a year positively impacts the grades of students who had gossip spread about them, whom their colleagues made fun of, whom their belongings were destroyed (mathematics grads) and those who were left out. All these dimensions had, in the PSM methodology, a positive effect on the grade, which can be explained since the model does not consider the intensity of aggressions. When placing the frequency in the estimation, it is noticed that this effect is only positive for those who were bullied once a year, that is, the frequency of aggressions is very low.

This result corroborates with that found by Ponzo (2013) in which student performance decreases as the frequency with which children are exposed to bullying increases. Eriksen et al. (2014) found that students' grades tend to be more impacted according to the intensity of the act. The frequent bullying suffered by children has several impacts on the victim's academic performance, on their desire to attend classes and their self-esteem (Rigby 2004). Victimized students tend to present a lower class attendance (Berthold and Hoover 2001; Cornell et al. 2013; Van Der Werf 2014). About 9% of students who were often bullied, according to the average of OECD countries, reported that they missed classes more than three or four times in the two weeks preceding the test (OCDE 2017). According to Due et al. (1999) failure to attend school translates into poor academic results. Thus, the performance of students who have reported being bullied a few times a month or a few times a week has a greater impact on academic performance since these students end up not attending classes.

In addition, being spanked is the type of bullying that affects the performance of students most, with Reading being the most impacted grade. The same occurred in the estimation by PSM since this type of aggression among those analyzed in the present study is the easiest to identify (OCDE 2017). The dimension of being left out, which by the estimation of the PSM had no significance, behaves differently when the frequency is incorporated into the model. Thus, for all estimated categorical multivalued models and for all PISA subjects, as bullying becomes more frequent the grade is negatively impacted. Therefore, frequency analysis is important to understand the impact of different types of bullying on students' grades.

5 Limitations

One of the limitations of this study is linked to the identification of psychological and indirect bullying, since the victim often does not know that they are suffering the aggression. Therefore, the results may be underestimated, which could justify the positive behavior in the students' grades.

In addition, the age of the students is also one of the limitations of this research. The high age-grade distortion can be one of the reasons for the elevated percentage of young people who report being bullied in Brazil. According to Harris et al. (2019), students who have failed a grade more than once would tend to report more the bullying they have suffered. However, through data of PISA it is not possible to control for the distortion between age and grade.

In Brazil, the age of 15 is marked by the transition from elementary to high school. For students this often represents a change of schools and, consequently, of colleagues. Thus, new groups are formed, and new hierarchies established (Ballatore et al. 2020). However, through PISA data, we were unable to identify the number of school changes that occurred during the student's academic path.

The reverse causality between bullying and school performance may exist. That is, it is still unclear whether poor school performance causes bullying or whether bullying causes low school performance, given that these students miss more classes and participate less in school activities (Berthold and Hoover 2001; Wolke et al. 2013; Van Der Werf 2014).

6 Final Considerations

Bullying negatively affects the formation of human capital in schools. Thus, understanding the causal effects of the several aspects related to this variable in students' learning becomes a relevant subject for the creation of public policies. Bullying impacts the mental and personal development of the student, which sometimes may continue in adulthood. Through the present study it was possible to identify which types of bullying negatively impact the grades of students.

This type of violence brings several consequences to the student besides the decrease of school performance because it may lead to an early dropout of the student life and, sometimes, difficulties in the labor market. Victims of bullying have greater risk to fail academically, as well as greater chances of weak performance at work (Wolke et al. 2013). Studies point out the psychological issued that children facing this type of aggression may have, such as anxiety, depression and shyness.

Including the frequency of bullying into the model provided additional information in the investigation of the estimated results. For most dimensions, the more frequent the bullying, the greater the negative impact on students' grades. In addition, the positive effect on the average through the PSM model can be explained since it is related to students who reported having suffered aggression a few times a year. When attacks are monthly or weekly, the impacts are negative and increasing. Thus, assessing the frequency of bullying is essential to understand the impacts on students' academic performance.

The present study highlights the importance of articulating different social actors and different sectors of society in order to implement public policies focusing on attitudes

of peace and healthy coexistence. In Brazil there is a law that establishes the Program of Fight against Systematic Intimidation (Bullying).[4] In article 6 it is established the provision of bi-monthly reports regarding the occurrence of bullying in States and Municipalities to plan the next actions. However, this law has not been fulfilled and there is no notice regarding the reports. In addition, it is necessary to alert parents, teachers, and students about this theme, since acts of bullying happen mostly outside the view of adults, and a great part of the victims do not report them. Its prevalence is still underestimated by society, nevertheless intervention is necessary to reduce and interrupt such situations.

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Appendix

Table 6 Results of *logit*

Variable	Having gossip spread	Being spanked	Being threatened	Having belongings destroyed	Made fun of	Being left out
private	0.22**	−0.13	−0.4***	−0.03	0.24***	0.3***
male	0.04	0.66***	0.45***	0.37***	0.5***	0.2***
schoolarity_father	0.0002	−0.019	0.03	0.017	0.004	0.001
schoolarity_mother	0.068***	0.09***	0.06***	0.05***	0.03**	0.03**
assets_home	−0.1	−0.32**	−0.28**	−0.16	−0.11	−0.12
assets_cultural	0.08*	0.18***	0.19***	0.15***	0.11***	0.07*
assets_family	0.13	0.21*	0.25**	0.14	0.04	0.04
grade_repetition	0.06*	0.36***	0.39***	0.22***	0.0009	0.05
age	−0.13	−0.38***	−0.26**	−0.29***	−0.12	−0.17**
size_class	−0.008***	−0.003	−0.007	−0.001	−0.007**	−0.007**
number_teachers	0.002	−0.0008	−0.001	−0.0002	0.003**	0.0009
number_girls	0.009	−0.004	−0.007	−0.006	−0.001	0.001
number_boys	−0.02**	0.003	0.013	0.003	−0.008	−0.01
like_me	−0.28***	−0.27***	−0.27***	−0.02	−0.02	−0.25***
feel_dislocated	0.34***	0.51***	0.49***	0.42***	0.264***	0.31***
feel_belongging	0.06	0.015	0.12	−0.015	0.05	0.027
friendship_easy	0.16***	0.07	0.07	0.04	0.06	0.067
feel_weird	0.31***	0.46***	0.39***	0.46***	0.45***	0.61***
feel_alone	0.27***	0.2**	0.135	0.09	0.31***	0.36***
_cons	0.61	2.56	1.216	2.02	0.092	1.18

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Source: Self elaboration from data of PISA (2015)

[4] Available at: http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2015/lei/l13185.htm

Table 7 Balancing pre and post pairing

	Pseudo-R^2	LR chi^2	P value	Average Bias	Average Median
non_paired	0.024	260.72	0	10.3	9.3
paired	0.002	9.73	0.973	1.4	1.1

Source: Self elaboration from data of PISA (2015)

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