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Andréa Tenório Correia da Silva

`andreatenorio@usp.br`

Universidade de São Paulo

Helena M. Constante

University of Manchester

João L. Bastos

Simon Fraser University

Ana Flávia Pires Lucas D'Oliveira

Universidade de São Paulo

Giselle Klautau

Beneficência Portuguesa de São Paulo

Rosane Lowenthal

Beneficência Portuguesa de São Paulo

Maria Fernanda Tourinho Peres

Universidade de São Paulo

Maria Tavares Cavalcanti

Universidade Federal do Rio de Janeiro

Marcia Thereza Couto

Universidade de São Paulo

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Intersectional Mistreatment Across Key Stages in Medical Education: A Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy.

Andréa Tenório Correia da Silva, PhD - corresponding author

Universidade de São Paulo, São Paulo, Brazil

E-mail: andreatenorio@usp.br

ORCID 0000-0002-3403-5792

Helena M. Constante, PhD

Department of Sociology, University of Manchester, Manchester, United Kingdom.

ORCID 0000-0001-9475-5786

João L. Bastos, PhD

Simon Fraser University, Faculty of Health Sciences, Burnaby, Canada.

ORCID 0000-0002-1816-0745

Ana Flávia Pires Lucas d'Oliveira, PhD

Faculdade de Medicina, Universidade de São Paulo, São Paulo, Brazil.

ORCID 0000-0003-1456-4184

Giselle Klautau, PhD

Faculdade BP, São Paulo, Brazil

ORCID 0000-0003-2594-3366

Rosane Lowenthal, PhD

Faculdade BP, São Paulo, Brazil

ORCID 0000-0002-6330-850X

Maria Fernanda Tourinho Peres, PhD

Universidade de São Paulo, São Paulo, Brazil.

ORCID 0000-0002-7049-905X

Maria Tavares Cavalcanti, PhD

Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

ORCID 0000-0002-9390-4652

Marcia Thereza Couto, PhD

Universidade de São Paulo, São Paulo, Brazil.

ORCID 0000-0001-5233-4190

Abstract

Background

Prior quantitative studies examined associations between student characteristics and mistreatment by treating social categories as independent factors. However, intersecting identities reflect how systemic oppression operated within hierarchical medical training environments and the hidden curriculum. We investigated mistreatment among Brazilian medical students using a quantitative intersectional approach to understand how social identities jointly shape vulnerability to mistreatment.

Method

We conducted an online survey across two Brazilian medical schools, assessing sociodemographic characteristics (gender, race, sexual orientation), training stage (basic, pre-clinical, clerkship), and experiences of mistreatment over the previous 12 months (insults, humiliation, threats, sexual harassment, physical aggression). We performed a Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) to model the intersectional effects of social identities on mistreatment across training stages. We examined 35 intersectional strata.

Results

Overall, 68.5% of participants reported experiencing mistreatment, with prevalence increasing from 52.2% in the basic stage to 80.2% during clerkship. Across intersectional strata, lesbian/bisexual women and gay/bisexual men consistently reported higher frequencies of mistreatment than heterosexual students. During basic and pre-clinical stages, White women reported higher mistreatment frequencies than Black and Brown women, a disparity that dissipated during clerkships. In the full model, between-strata variance decreased by nearly 90%, and the variance partition coefficient dropped from 17.3% to 2.1%.

Conclusions

Intersecting social identities dynamically shape medical students' vulnerability to mistreatment across training stages. Institutional strategies must move beyond single-identity frameworks to address intersectional mistreatment. At the medical school level, key actions include anti-mistreatment training that addresses implicit biases and power

dynamics, safe reporting systems, and routine evaluations. At the policy level, specific diversity, equity, and inclusion (DEI) criteria should be included in medical school evaluation systems, alongside policies aimed at mitigating inequitable access to medical schools for transgender and nonbinary individuals.

Key words: medical education, intersectional framework, mistreatment, Brazil, multilevel analysis

Background

Previous research, particularly in the Global North, has described mistreatment in medical education as a prevalent and concerning phenomenon. A recent meta-analysis found that nearly 60% of medical students experience at least one form of harassment or discrimination during their training.[1] Although early quantitative studies showed that female, non-White students,[1] and LGBTQ+ students[2] faced a higher risk of mistreatment, subsequent investigations have explored how multiple identities combine to predict these experiences in an additive fashion.[3] For instance, Teshome et al.[4] found that non-White lesbian/bisexual women reported the highest frequency of recurrent mistreatment among medical students. Despite these insights, quantitative analyses evaluating medical student mistreatment through an intersectional approach remain limited.

Mistreatment in medical education is deeply embedded in the hidden curriculum, which is defined as the implicit norms, values, and behaviors transmitted through role modeling, organizational culture, and daily interactions.[5–7] A core component of the hidden curriculum is hierarchy, which ranks individuals from the highest tiers (e.g., faculty and residents) to the lowest (undergraduate students).[8] This hierarchical structure shapes the relationships between students and faculty, particularly during clinical training.[9] Furthermore, it can normalize unprofessional behaviors, intimidation, humiliation, bullying, and shame-based learning as accepted components of the learning process,[10] thereby legitimizing trainee mistreatment.[11, 12] Ultimately, this organizational culture contributes to stress and burnout while compromising patient safety and quality of care.[8, 13]

Mistreatment in medical education often reflects complex dynamics among social categories such as gender, race/ethnicity, sexual orientation, and hierarchy.[14] Elucidating these dynamics requires advanced analytical frameworks, such as an intersectional

perspective. Coined by Crenshaw[15] in the late 1980s, intersectionality describes how social categories, positions, and systems of oppression intersect to shape individual and group experiences.[16] Beyond providing a lens for analyzing discrimination, it offers a framework to examine the institutional and structural dimensions that perpetuate oppression across health and education systems.[17] Oppression operates across different interconnected levels, including structural (institutions and policies), cultural (norms and values), interpersonal, and internalized dimensions. Although intersectional approaches have historically been qualitative, quantitative methods aligned with this framework have recently emerged. Nevertheless, the application of intersectionality as both a theoretical and analytical tool in medical education remains overlooked.[18, 19]

Among emerging quantitative intersectional frameworks, Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) has been increasingly applied to measure social and health inequities across diverse populations, including university students[20] and academic staff.[21] Widely regarded as a new gold standard for quantitative intersectional analysis,[22] MAIHDA evaluates intergroup differences while accounting for the structural social relations that perpetuate inequality[22, 23]. To date, no previous study has employed MAIHDA to examine mistreatment in medical education. Brazil represents a compelling Global South context where research on mistreatment must account for intersecting dimensions of injustice. Unlike many countries in the Global North, over 55% of the Brazilian population is Black. Yet, the myth of racial democracy and colorblindness, that contributes to denying or minimizing structural racism, continues to shape social practices and institutional norms.[24] Furthermore, Brazilian society has been historically built on nearly 400 years of slavery, the objectification of women and other minoritized genders, and the marginalization of LGBTQIA+ populations.[25]·[26]

Over the last decade, the landscape of medical education in Brazil has undergone a dramatic transformation. First, the number of medical schools has expanded rapidly, more than doubling from 223 in 2014 to 448 in 2024. Second, student demographics have shifted significantly, with women representing 61.8% of medical students in 2023.[27] Third, affirmative actions and inclusion policies based on race/ethnicity and socioeconomic status, such as the Racial Quota System[28] and the University for All program (PROUNI),[29] were widely implemented. Consequently, Brazil provides a valuable Global South context to

examine mistreatment in medical education through an intersectional approach. This study aimed to investigate predictors of self-reported mistreatment in medical education using MAIHDA, focusing on four intersecting dimensions: gender, race/ethnicity, sexual orientation, and stage of training.

Methods

Study design and participants

We conducted a cross-sectional online survey at two Brazilian medical schools—one public institution in Rio de Janeiro and one private institution in São Paulo, both located in two of the largest metropolitan areas in Latin America. All medical students who were regularly enrolled in academic activities were eligible to participate. Students accessed the self-administered questionnaire via a QR code. Response rates were 38.7% at the public school and 43.6% at the private school, yielding an analytical sample of 685 respondents who fully completed the questionnaire.

Dependent variable

The primary outcome was self-reported mistreatment within the previous 12 months. Students were asked whether they had experienced any form of mistreatment and, if so, to indicate the specific type(s): insults or humiliation, threats, sexual harassment, or physical assault. We adapted the WHO multi-country study on women's health and domestic violence (Brazilian version) questionnaire[30, 31] to investigate mistreatment in medical education settings. For analytical purposes, participants were categorized according to a binary variable: having reported no mistreatment versus having experienced at least one type of mistreatment (supplementary material 1).

Social categories

Individual characteristics included self-reported gender identity, sexual orientation, race/ethnicity, and stage of medical training. Regarding gender identity, participants could select from the following options: cisgender man, cisgender woman, transgender man, transgender woman, or non-binary. Sexual orientation was categorized into "heterosexual" and "gay/lesbian/bisexual/other." Race/ethnicity was classified into five categories according to the Brazilian Institute of Geography and Statistics (IBGE) standard definitions: White, Black, Yellow (i.e., participants of Asian ancestry), Brown (i.e., mixed-race respondents), and

Indigenous. Due to small sample sizes, Indigenous ($n = 1$) and Yellow ($n = 12$) participants were excluded from the analytical sample.

Finally, participants were categorized into three groups according to their stage of training: "Basic science" (first and second years), "Pre-clinical" (third and fourth years), and "Clerkship" (fifth and sixth years). We conceptualized training stage as a social category within our intersectional framework because it operationalizes institutional hierarchy, which ranks students along power gradients from the highest tiers (faculty/physicians) to the lowest (early-stage undergraduates).[8] This structural hierarchy constitutes a core component of the hidden curriculum that systematically shapes medical student experiences and reproduces power asymmetries throughout medical training.[13]

Analytical approach

Descriptive statistics were first used to calculate relative frequencies and corresponding 95% confidence intervals (95% CI) for sample characteristics and self-reported mistreatment across social categories. Using MAIHDA, we constructed 35 intersectional strata by combining all categories of gender, sexual orientation, race/ethnicity, and stage of training. Each stratum represents individuals who share the same set of defining characteristics (e.g., Black lesbians). Notably, no participants belonged to the "heterosexual Black men in clerkship" stratum.

Intersectional strata were treated as level-2 units, while individuals within each stratum were considered level-1 units. This approach enables the separation of variability that exists between and within intersectional strata.

A simple variance component model (null model) was initially specified to estimate the total variability in self-reported mistreatment across the 35 strata. In this step, the mean sample size per stratum was 19.6 students (range: 1 to 112). Subsequently, a full model was estimated by incorporating each identity axis as fixed main effects. This hierarchical structure decomposed variance into two components: (1) between-stratum variation, reflecting differences across intersectional social positions resulting from shared exposure to structural systems of privilege and oppression (e.g., racism, sexism, and heterosexism); and (2) within-stratum variation (individual heterogeneity), capturing differences among individuals sharing the same intersectional profile due to unmeasured personal or contextual factors.

Equation

$$Y_{ij} \sim \text{Bernoulli}(\pi_{ij})$$

$$\text{logit}(\pi_{ij}) = \beta_0 + \sum_{k=1}^6 \beta_k X_{kij} + u_j$$

$$u_j \sim N(0, \sigma_u^2)$$

Where: Y_{ij} is the mistreatment outcome for individual i in stratum j ; π_{ij} is the probability of mistreatment; β_0 is the fixed intercept; β_k are the six fixed effects for sex, sexual orientation, race, and medical phase; u_j is the random intercept for intersectional stratum j . Of note, i indexes individuals and j indexes intersectional strata.

Starting values for both models were derived using second-order penalized quasi-likelihood (PQL2) estimation. Final model parameters were estimated via Markov chain Monte Carlo (MCMC) procedures, which provide robust posterior distributions for binary outcomes.[32] We evaluated the analytical utility and performance of the MAIHDA approach using three key metrics: (1) Variance Partition Coefficient (VPC),[23] which reflects the proportion of total mistreatment variance attributable to differences between intersectional strata. Comparing the VPC between the null and full models indicates whether between-stratum differences are driven primarily by additive main effects or by interactive intersectional effects. A full-model VPC near zero suggests that disparities are predominantly additive; this information is essential to determine if MAIHDA is justified; if no multiplicative effects are found, traditional regression would be indicated instead to capture marginal effects across social dimensions; (2) Proportional Change in Variance (PCV) between the null and full models. The PCV distinguishes variance explained by additive effects from residual variance that may reflect intersectional effects, thereby evaluating the feasibility of the MAIHDA approach. A PCV near 100% would suggest that the fixed effects largely account for intersectional variance,[22] though insufficient sample sizes could limit detection of smaller interaction effects; and (3) Area Under the Receiver Operating Characteristic Curve (AUC) evaluates discriminatory accuracy, specifically, the probability that an individual who experienced mistreatment belongs to a stratum with a higher predicted probability of mistreatment than an individual who did not. AUC values range from 0.5 to 1.0, with 1.0

indicating perfect accuracy, but considering that in MAIHDA the model relies on broad identities (e.g., race, gender, sexual orientation), which may not fully capture individual-level variation, higher AUC values might not be expected given the aggregated nature of these variables.[22]

Finally, we plotted the predicted values of the intersectional strata and their respective residuals following the full model. Analyses were conducted using Stata 18.0[33] for general procedures, with MAIHDA models estimated in MLwiN software (version 3.17)[34] via the *runmlwin* function.

Results

The sample was primarily comprised of cisgender women (70.1%), heterosexual individuals (75.5%), and White respondents (72.7%). Regarding the stage of training, nearly 37% of participants were in the basic science stage, 35.0% in the pre-clinical stage, and 28.0% in the clerkship stage (Table 1). Overall, the prevalence of self-reported mistreatment was 68.5%. Mistreatment was reported by 70.4% of cisgender women and 72.6% of respondents identifying as lesbian, gay, bisexual, or another non-heterosexual orientation. Across all racial groups, reported rates exceeded 64.0%. Furthermore, the frequency of mistreatment increased progressively across training stages (52.2% in the basic science stage to 80.2% in the clerkship stage).

Table 1. Distribution of the analytical sample and prevalence of mistreatment according to intersectional strata dimensions among Brazilian medical students (n=685).

	Sample distribution	Mistreatment
	% (95% CI)	≥ 1 type or more*
Gender		
Cisgender men	29.93 (26.61-33.47)	63.90 (57.09-70.20)
Cisgender women	70.07 (66.53-73.39)	70.42 (66.17-74.34)
Sexual orientation		
Heterosexual	75.47 (72.11-78.56)	67.12 (62.94-71.04)
Gay, Lesbian, Bisexual, Other	24.53 (21.44-27.89)	72.62 (65.38-78.84)
Race		
White	73.72 (70.29-76.89)	69.31 (65.14-73.18)
Brown	21.02 (18.13-24.24)	66.67 (58.57-73.89)
Black	5.26 (3.81-7.20)	63.89 (47.23-77.76)
Medical course stage		
Basic	36.93 (33.39-40.62)	52.17 (46.01-58.28)

Pre-clinical	35.04 (31.55-38.69)	76.25 (70.45-81.22)
Clerkship	28.03 (24.79-31.52)	80.21 (73.96-85.26)
Total	100.00	68.47 (64.88-71.84)

95% CI – 95% Confidence Interval; * Types of mistreatments: insults/humiliation, threats, sexual harassment, and physical aggression

Table 2 presents the results from the MAIHDA models. In the null model, the random effect yielded a between-strata variance of 0.68, with a Variance Partition Coefficient (VPC) indicating that 17.31% of the total variance in self-reported mistreatment was attributed to differences between intersectional strata. In the full model, between-strata variance decreased by nearly 90% (from 0.68 to 0.07), and the VPC was substantially reduced to 2.03%. This reduction suggests that the variance in self-reported mistreatment was mostly explained by the difference between intersectional strata, with only 2.03% of the between-strata variance remaining unexplained by additive terms. The Proportional Change in Variance (PCV) further demonstrated that additive main effects accounted for 90% of the between-strata variation in self-reported mistreatment, whereas 10.0% was attributable to intersectional interaction effects. Finally, the full model yielded an area under the receiver operating characteristic curve (AUC) of 0.67, indicating moderate accuracy in predicting individual mistreatment reports, substantially better than chance (0.50), but it did not reach high accuracy (close to 1.0).

Table 2. Parameters estimates from the multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA) of mistreatment among Brazilian medical students.

Parameters	Null model OR (95% CI)	Full model OR (95% CI)
Fixed-effect parameters		
Gender		
Cisgender women		1.45 (0.89–2.19)
Sexual orientation		
Gay, Lesbian, Bisexual, Other		1.47 (0.90–2.22)
Race		
Brown		0.82 (0.46–1.30)
Black		0.92 (0.38–1.90)
Medical course stage		
Pre-clinical		3.08 (1.96–4.54)
Clerkship		3.94 (2.37–6.14)
Model intercept	2.36 (1.57-3.42)	0.85 (0.54–1.32)
Random-effects parameters		

Between-strata variance (SD)	0.69 (0.36)	0.07 (0.09)
Summary statistics		
VPC (%)	17.31	2.03
PCV (%)		90.11
AUC	0.71	0.67

Reference categories: cisgender men, heterosexual, white, basic stage; OR – odds ratio; 95% CI – 95% Confidence Interval; SD – standard deviation; VPC - Variance partition coefficient; PCV - Proportional change in variance; AUC - Area Under Receiver Operating Characteristic Curve.

Figure 1 illustrates the predicted prevalence of self-reported mistreatment across all intersectional strata, with key findings highlighted in Table 3. A primary finding is the pronounced impact of the stage of training: lower predicted prevalence rates were consistently observed among students in the basic science stage, whereas the highest rates were concentrated among those in the clerkship stage. Overall, heterosexual men in the basic science phase exhibited the lowest predicted prevalence of mistreatment, remaining substantially below the overall strata average (68.7%). Specifically, the lowest values were observed among Black (40.2%; 95% CI, 20.6%–63.5%) and Brown (Pardo) heterosexual men (40.5%; 95% CI, 25.3%–57.8%) in this initial stage. Conversely, women identifying as lesbian, bisexual, or another non-heterosexual orientation in the advanced training stages demonstrated the highest predicted prevalence. The highest values were observed among White lesbian/bisexual/other women in the pre-clinical stage (85.3%; 95% CI, 72.6%–92.7%) and Black lesbian/bisexual/other women in the clerkship stage (85.2%; 95% CI, 66.6%–94.3%).

Figure 1. The predicted prevalence of mistreatment by all intersectional strata ranked from lower to higher across stages of medical training, according to the random-effects full model.

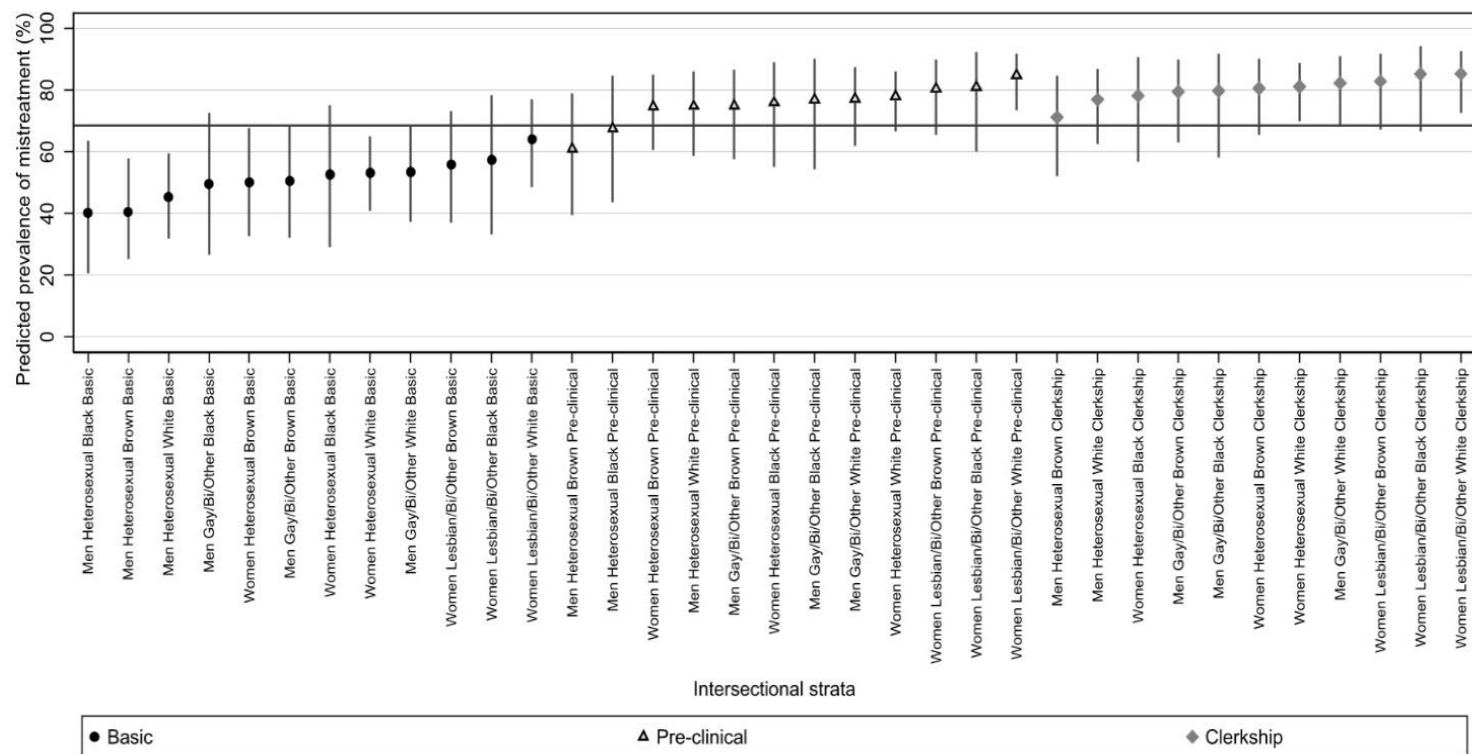
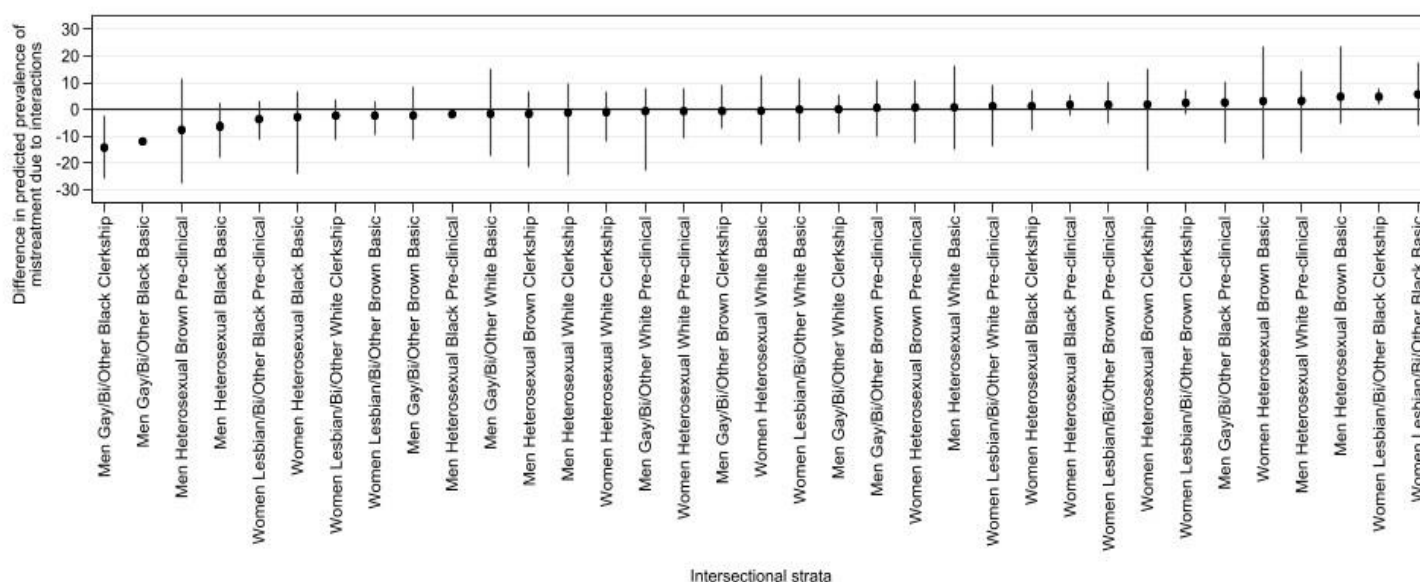


Table 3. Description of the intersectional strata according to the predicted prevalence of mistreatment among Brazilian medical students.

Strata	Mistreatment	
	%	95% CI
Five lowest-ranked predicted prevalence of mistreatment		
Men Heterosexual Black Basic	40.21	20.62–63.52
Men Heterosexual Brown Basic	40.50	25.27–57.81
Men Heterosexual White Basic	45.36	31.85–59.59
Men Gay/Bi/Other Black Basic	49.59	26.76–72.59
Women Heterosexual Brown Basic	50.12	32.62–67.60
Five highest-ranked predicted prevalence of mistreatment		
Men Gay/Bi/Other White Clerkship	82.31	68.15–91.00
Women Lesbian/Bi/Other Brown Clerkship	82.88	67.22–91.95
Women Lesbian /Bi/Other White Pre-clinical	84.86	73.34–91.95
Women Lesbian /Bi/Other Black Clerkship	85.22	66.62–94.34
Women Lesbian /Bi/Other White Clerkship	85.29	72.56–92.71
Strata with 95% CI below the average predicted prevalence of mistreatment (68.65%)		
Men Heterosexual Black Basic	40.21	20.62–63.52
Men Heterosexual Brown Basic	40.50	25.27–57.81
Men Heterosexual White Basic	45.36	31.85–59.59
Women Heterosexual Brown Basic	50.13	32.62–67.60
Women Heterosexual White Basic	53.18	40.99–64.99
Strata with 95% CI above the average predicted prevalence of mistreatment (68.65%)		
Women Heterosexual White Clerkship	81.15	68.84–88.90
Women Lesbian /Bi/Other White Pre-clinical	84.86	73.34–91.95
Women Lesbian /Bi/Other White Clerkship	85.29	72.56–92.71

Figure 2 illustrates the difference in predicted probabilities of self-reported mistreatment between the total predicted probabilities for each intersectional stratum and the probabilities based solely on additive main effects of strata dimensions. The central trend (horizontal line at zero) alongside the 95% confidence intervals (spikes) reveals some variability across strata, with some overlapping at zero, indicating no significant differences for those strata. These findings suggest that intersectional effects play a modest but variable role in explaining differences in predicted probabilities across intersectional strata. Nevertheless, due to the very small sample sizes in some strata (e.g., Black gay/bisexual/other men in the basic science stage, Black heterosexual men in the pre-clinical stage), the predicted differences lack precision, and the 95% confidence intervals could not be reliably estimated for those strata; consequently, these specific estimates should be interpreted with caution.

Figure 2. Predicted interaction effects for each stratum, ranked from lowest to highest. Markers represent the differences in predicted values for each stratum, while spikes show the approximate 95% confidence intervals.



Discussion

Our major findings were: (1) the variance in self-reported mistreatment was mostly explained by differences between intersectional strata; (2) the stage of the medical training played an important role in predicted self-reported mistreatment, and the frequency of mistreatment increased progressively from the basic science stage (52.2%) to the clerkship stage (80.2%); and (3) across all course stages of medical training, lesbian/ bisexual women had a higher predicted frequency of mistreatment than heterosexual women, heterosexual men, and gay/bisexual men. Across the basic and pre-clinical stages, White women presented a higher frequency of mistreatment than Black and Brown women; however, this difference did not persist during the clerkship stage. Notably, gay/bisexual men had a higher frequency of mistreatment than their heterosexual counterparts across all stages of medical training. By adopting an intersectional approach, our study highlights the importance of accounting for multiple axes of marginalization to better understand mistreatment in medical education.

Previous studies have shown that women, minoritized racial or sexual identity groups,[1, 14, 35] and students in more advanced stages of medical training[35, 36] reported higher frequencies of mistreatment. However, most prior research has examined these student characteristics in isolation. Only recently have studies begun to assess these dimensions in conjunction. For instance, Teshome *et al.*

demonstrated that non-White lesbian and bisexual women faced a higher risk of recurrent mistreatment.[4]

By utilizing MAIHDA, we analyzed 35 intersectional strata to evaluate intergroup differences while accounting for systemic social and structural inequalities. Our findings indicate that individual variation in self-reported mistreatment was partially driven by intersectional group differences, underscoring that intersectional lens is critical to understanding mistreatment in medical education. Consequently, there is an urgent need to elucidate how sexism, racism, and anti-LGBTQIA+ bias shape interpersonal relationships and student experiences during training. These dynamics not only jeopardize the learning environment but also perpetuate the hidden curriculum—validating an institutional culture that normalizes mistreatment as an inherent component of medical education.[11, 12] Within this culture, entrenched hierarchical power structures continue to privilege heterosexual White male identities at the top of the social hierarchy.[10] This hierarchy profoundly shapes relationships between medical students and faculty, particularly in more advanced training stages.[9, 10] Such dynamics are often intensified during clerkships, as students in clinical settings navigate high-stakes relationships that directly influence their career prospects, residency opportunities, and professional standing. Furthermore, institutional hierarchy creates a systemic barrier where reporting mistreatment is widely perceived as ineffective or even harmful to one's career progression,[37] thereby reinforcing disrespectful, unprofessional, and unethical behaviors as normalized components of the educational process. The higher prevalence of mistreatment in the clerkship stage was also observed in previous studies,[38] making clerkships a priority area for preventive actions.

The counterintuitive finding that White women demonstrated higher predicted prevalence of mistreatment than Black and Brown women during basic science and pre-clinical stages invites theoretical consideration. The mechanism that might explain this pattern is anchored in Brazil's deeply embedded myth of racial democracy. Rooted in the idea of a mixed-race country, immune to systemic racism, this myth operates to delegitimize claims of racial discrimination and normalizes its invisibility.[39] It is frequently reinforced by colorblind discourse, creating barriers that discourage Black and Brown students from labeling and reporting racial mistreatment.[40] Consistent with this, qualitative research among Black medical students in Brazil reveals that racist experiences—including exclusion, jokes about physical appearance, and low faculty representation—are frequently not identified as racism even by those who directly experience them, reflecting the internalized, interpersonal, and institutional dimensions of structural racism.[41, 42] Other barriers to reporting mistreatment include fear of reprisal, damage to the student–teacher relationship, the perception of mistreatment as part of medical education culture, the

belief that more subtle forms of mistreatment are not relevant enough to be reported, and empathy with the perpetrator.[43] Consequently, identifying and reporting mistreatment might be particularly difficult for Black and Brown women in the early stages of the medical training.

Intersectionality uncovers how racism, sexism, and anti-LGBTQIA+ bias interact, allowing us to better understand the mechanisms that perpetuate health and social inequities.[44] To this end, it is crucial to recognize the intersecting relationships among these systems of oppression as structural components of the hidden curriculum, which includes hierarchical dynamics that can contradict formal curriculum teachings on anti-racism, anti-sexism, and anti-LGBTQIA+ bias. Applying intersectional concepts and frameworks is fundamental to shaping meaningful diversity, equity, and inclusion (DEI) programs in medical schools. Such frameworks are essential to ensuring an equitable learning environment for students and faculty, while ultimately safeguarding patient care.[44] Furthermore, addressing intersectional mistreatment is critical to mitigating its severe impacts on physical and mental health, including depression, anxiety, burnout, and sleep disorders,[36, 45, 46] as well as, preventing academic decline and attrition among minoritized medical students.[47] These insights carry international relevance: global accreditation frameworks—including those of the World Federation for Medical Education (WFME) and the Accreditation System of Medical Schools in Brazil (SAEME)[48]—increasingly require medical schools to demonstrate equitable learning environments across diverse student populations. Moreover, empirical evidence from contexts like Brazil provides concrete benchmarks for institutions worldwide navigating intersectional DEI reform.

The implications of intersectional mistreatment for patient care extend beyond medical school. Burnout stemming from mistreatment has been associated with racial biases among physicians-in-training, opening a direct pathway through which hostile training environments can compromise care equity for patients.[49] Furthermore, the loss of minoritized trainees due to mistreatment can affect a workforce that disproportionately serves underserved and historically excluded communities: physicians from historically marginalized racial and ethnic backgrounds are more likely to practice in medically underserved areas and to care for patients in public health systems, making their retention a prerequisite for equitable access.[50, 51] Because racial and ethnic concordance between patients and clinicians is associated with better communication, greater trust, and higher adherence to care plans, the loss of minoritized physicians carries measurable consequences for the populations most in need of culturally responsive care.⁴² Beyond workforce composition, the hidden curriculum that normalizes mistreatment shapes professional identity during the very period when future physicians internalize the values, attitudes, and relational behaviors they will carry into clinical practice. Training environments that

tolerate intersectional mistreatment therefore risk producing a physician workforce ill-prepared to deliver compassionate, equitable care—particularly for patients from the same marginalized groups whose experiences of discrimination in the healthcare system may mirror those endured by healthcare providers from these groups during medical training. Addressing intersectional mistreatment at its structural roots is therefore not merely an institutional equity imperative but a prerequisite for patient-centered care and health justice.

The findings from this study extend beyond the Brazilian context and carry direct relevance for the international medical education community. Methodologically, MAIHDA offers a rigorous and exportable framework for examining intersectional disparities in any setting with sufficient subgroup data—institutions in Europe, North America, and beyond can adopt this approach to quantify which student identities, in combination, drive vulnerability to mistreatment. Contextually, Brazil's unique sociohistorical trajectory, characterized by marked racial heterogeneity, major federal equity policies (Law 12.711/2012; PROUNI), and rapid medical school expansion, constitutes a natural experiment in how systemic DEI interventions interact with entrenched hierarchies of race, gender, and sexual orientation across successive training stages. The convergence of these findings with results from studies conducted in the Global North suggests shared mechanisms of structural inequality in academic medicine; yet, the divergent racial dynamics documented here underscore that context-specific intersectional analyses are indispensable, as universal frameworks may overlook local systems of oppression that only locally grounded data can reveal.

Strengths and limitations

To our knowledge, this is the first study to conduct a quantitative intersectional analysis evaluating mistreatment in medical education. Utilizing the MAIHDA approach enabled us to rigorously quantify the extent to which individual variation in self-reported mistreatment was explained by differences between intersectional strata differences compared with additive effects. Another key strength is the study setting: Brazil has experienced a significant expansion of medical schools and DEI initiatives over the past two decades, and, in 2015, implemented an Accreditation System of Medical Schools recognized by the WFME, positioning Brazil as a comparative reference point for international institutions navigating DEI transitions—particularly those shaped by affirmative action policies such as Law 12.711/2012 and PROUNI.

Nonetheless, several limitations should be considered. First, our sample was drawn from two medical schools located in a large urban metropolitan area, which may limit the generalizability of our

findings to institutions in rural or resource-constrained regions. Second, the response rate represents a potential source of non-response bias. Third, due to small sample sizes in specific intersectional strata, we were unable to evaluate certain minoritized groups, including transgender, Asian, Indigenous, and Black gay students. However, this sample constraint itself reflects structural barriers in Brazilian medical education, indicating that existing DEI policies have yet to guarantee equitable access for historically marginalized populations.

Importantly, much of the global literature on medical student sociodemographics remains constrained by equating gender identity with biological sex, limiting response options to a binary male/female classification without accounting for cisgender, transgender, or non-binary identities. Furthermore, sexual orientation remains severely underrepresented in medical education research, particularly within the Global South. This silence highlights how key identity axes have been historically marginalized in academic medicine. LGBTQIA+ medical students face distinct systemic challenges, as disclosing their sexual orientation or gender identity may carry risks of discrimination, negatively impacting their learning environment, mental well-being, and professional advancement.[52] By explicitly measuring race, gender, and sexual orientation as intersecting axes through MAIHDA, this study addresses these methodological gaps and offers a transferable analytical template for future international research on intersectional identities in medical education.

Conclusion

Our findings demonstrate that individual variation in self-reported mistreatment is mostly explained by intersectional group differences, underscoring how intersecting social identities and hierarchical systems of oppression shape student experiences in medical education. Based on our results, actions to mitigate mistreatment in medical education should encompass structural interventions at both institutional and national policy levels. Medical schools should implement and evaluate: (1) anti-mistreatment training for students, faculty, and preceptors, preparing them to identify their implicit biases related to racism, sexism, and anti-LGBTQIA+ discrimination, and to recognize how intersecting systems of oppression establish norms, values, and behaviors that perpetuate the negative hidden curriculum; (2) safe and anonymous reporting systems to overcome the fear of retaliation deeply entrenched in the medical hierarchy, supported by non-retaliatory protocols; and (3) routine institutional evaluations to identify priority strata, track equity progress over time, and monitor the impact of anti-mistreatment policies. At the policy level, the Brazilian Ministry of Education should include specific DEI criteria in the national medical school evaluation system, such as the implementation of programs to

reduce barriers to recognizing and reporting mistreatment, alongside proactive preventive actions. In addition, it is necessary to establish a national policy to address inequitable access to medical schools for transgender and non-binary individuals.

List of abbreviations

MAHIDA - Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy

DEI Diversity, equity, and inclusion

PROUNI Brazilian University for All program

PCV Proportional Change in Variance

VPC Variance Partition Coefficient

AUC Area Under the Receiver Operating Characteristic Curve

MCMC Markov chain Monte Carlo procedures

WFME World Federation for Medical Education

SAEME Accreditation System of Medical Schools in Brazil

Declarations

Ethical approval and consent

This study was approved by the Institutional Review Board of the Institute of Psychiatry of the Federal University of Rio de Janeiro (approval No. 3.287.931) and the Santa Marcelina Association in São Paulo (approval No. 3.063.566) in accordance with the Declaration of Helsinki. Participant privacy and data confidentiality were strictly maintained. All respondents provided written informed consent electronically prior to participation.

Consent for publication

Not applicable.

Competing interests.

None declared.

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Authors' contributions

Silva ATC participated in the design and planning of the study, data collection and analysis, interpretation of the results, writing, and reviewing. Constante HM participated in data analysis, interpretation of the results, writing, and reviewing. Bastos JL advised about statistical methodology and participated in data analysis, and writing. D'Oliveira AFPL participated in data analysis, interpretation of the results, and writing. Klautau G participated in interpretation of the results, writing, and reviewing. Lowenthal R

participated in interpretation of the results, writing, and reviewing. Peres MFT participated in interpretation of the results, writing, and reviewing. Tavares MC participated in the design and planning of the study, data collection, interpretation of the results, writing, and reviewing. Couto MT participated in data analysis, advised about statistical methodology, interpretation of the results, writing, and reviewing. All of the authors reviewed and approved the final version.

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available due to containing sensitive participant information, but are available from the corresponding author on reasonable request.

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