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RESEARCH ARTICLE

Race-related population attributable fraction of preventable risk factors of dementia: A Latino population-based study

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Abstract

Background: Risk factors for dementia have distinct frequency and impact in relation to race. Our aim was to identify differences in modifiable risk factors of dementia related to races and estimate their population attributable fraction (PAF).

Methods: An epidemiological cohort was used to estimate the prevalence of 10 modifiable risk factors for dementia among five races—White, Black, Brown, Asian, and Indigenous. Sample weighting was used to estimate the prevalence and PAF of each risk factor in each race.

Results: A total of 9070 individuals were included. Overall adjusted PAF was the lowest in Indigenous (38.9%), and Asian individuals (41.2%). Race-related prevalence of individual risk factors was widely variable in our population, but hearing loss was the most important contributor to the overall PAF in all races.

Conclusions: Public policies aiming to reduce preventable risk factors for dementia should take into consideration the race of the target populations.

KEYWORDS
dementia, epidemiology, Latino, primary care, public health

HIGHLIGHTS

- Preventable risk factors for dementia vary according to race.
- Hearing loss presented the highest prevalence among all races studied.
- Indigenous and Asian individuals presented the lowest population attributable fractions.
- Black and Brown individuals were more vulnerable to social determinants.

Wyllians Vendramini Borelli and Carolina Rodrigues Formoso contributed equally as first authors for this study.

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1 | INTRODUCTION

Dementia is a leading cause of disability and dependency among older adults globally.[1] Accordingly, it is pivotal to seek potentially modifiable risk factors for dementia to guide public health strategies. A set of such factors was established in 2017 and updated in 2020 by the Lancet Commission. It consists of lower education attainment, hypertension, hearing impairment, smoking, obesity, depression, physical inactivity, diabetes, low social contact, alcohol consumption, traumatic brain injury, and air pollution.[2] The global percentages of dementia attributable to each risk factor were estimated using the population attributable fraction (PAF), which is defined as the proportion of disease cases preventable in a population if an individual risk factor were eliminated.[3]

Brazil is a large country with an important role economically and socially, especially in representing a middle-income country with a majority Latino population. It is composed of a multi-ethnic background with a variety of races and a higher percentage of modifiable risk factors for dementia than the global estimate,[4] though racial and ethnic disparities are clear nationwide. The profile of preventable risk factors is also distinct in Brazil, especially in regard to the high prevalence of hearing loss and physical inactivity. However, racial-specific differences in risk factors are not yet clear—especially in low- and middle-income countries (LMICs), where the majority of older adults with dementia live.[5]

Despite its massive social and economic impact, ethnic and racial differences in dementia physiopathology are still poorly understood. Black individuals have higher rates of dementia compared to White individuals, which was identified in studies conducted in the United States,[6,7] and corroborated by a meta-analysis including China and Singapore.[8] Potential explanations include higher vulnerability to risk factors, such as hearing loss[9] and cerebral microbleeds that tend to affect this race more than others.[10,11] Thus, Black older adults with dementia ultimately presented higher risk factors and worse cognitive profiles compared to White individuals, though with lower prevalence in the United States.[12] Regarding racial origin, a recent meta-analysis showed that there was no difference in the incidence of dementia between the Latino and Asian ethnicities compared to White individuals.[8] Nevertheless, the top three risk factors with the highest PAF for White individuals have confirmedly differed in Asians in a cohort in New Zealand.[13] Identifying these racial differences may consolidate a first step in changing the scenario of dementia. Moreover, it is remarkable that LMICs are underrepresented in the study of racial diversity. Thus, our aim is to estimate the impact of 10 modifiable risk factors among different races using an epidemiological cohort with nationwide representativity in a middle-income country.

RESEARCH IN CONTEXT

1. **Systematic review**: Literature was reviewed using the following terms: "dementia," "race," and "population attributable fraction." We did not find any study. We changed the term "population attributable fraction" to "prevalence" and "risk factor" and retrieved 13 studies.
2. **Interpretation**: The majority of studies retrieved used race to compare groups, but analysis was not to identify race-related differences (8/13). Three studies found that African Americans had higher cardiovascular risk factors, and one presented higher rates of white matter lesions. One study showed higher odds of dementia in Hispanics compared to White and Black individuals.
3. **Future Directions**: Even though prevalence of dementia among different races has been reported, a study on the impact of these prevalences in each race is still pivotal to guide public health strategies. This study proposes to identify the race-related effects of risk factors of dementia in an epidemiological study.

2 | METHODS

2.1 | Description of the ELSI-Brazil cohort

The ELSI-Brazil is a longitudinal and home-based survey, conducted in 2015 and 2016 in a nationally representative sample of older adults.[14] This sample is composed of 9412 individuals, aged 50 years and older, from 70 municipalities across the five geographical regions of Brazil (North, Northeast,Midwest, Southeast and South). The survey aimed to examine the social and biological determinants of aging and its consequences, with the goal of determining the demands of the Brazilian health-care system. It was coordinated by the Oswaldo Cruz Foundation-Minas Gerais (FIOCRUZ-MG) and the Federal University of Minas Gerais (UFMG). The baseline survey was funded by the Brazilian Ministry of Health and the Ministry of Science, Technology, Innovation, and Communication.

For this representative sample, the 2010 National Census carried out by the Brazilian Institute of Geography and Statistics (IBGE) was used to delineate the study design. The estimated sample size was 10,000 individuals, at a level of significance of 95%. The effective sample design was 1.5, allowing an estimated prevalence of 1% with a sample error of 0.25%. Furthermore, ELSI-Brazil adopted a similar methodology to other longitudinal aging studies around the world (i.e., the Health and Retirement family of studies), which offers an opportunity for cross-national comparison (Figure 1).

The research procedures included: (1) an interview about general household characteristics and socioeconomic conditions; (2) an individual clinical interview about physical health, mental health, and other relevant aspects; (3) blood pressure measurements, anthropometric measures, and a physical functioning assessment; and (4) blood collection. Detailed information about the ELSI-Brazil methodology can be found elsewhere.[14]

Importantly, this study included a multicultural population that comprehensively represents the Brazilian population. This portrays the natural diversity of this country, involving individuals of different races, sex, and incomes (Table 1).

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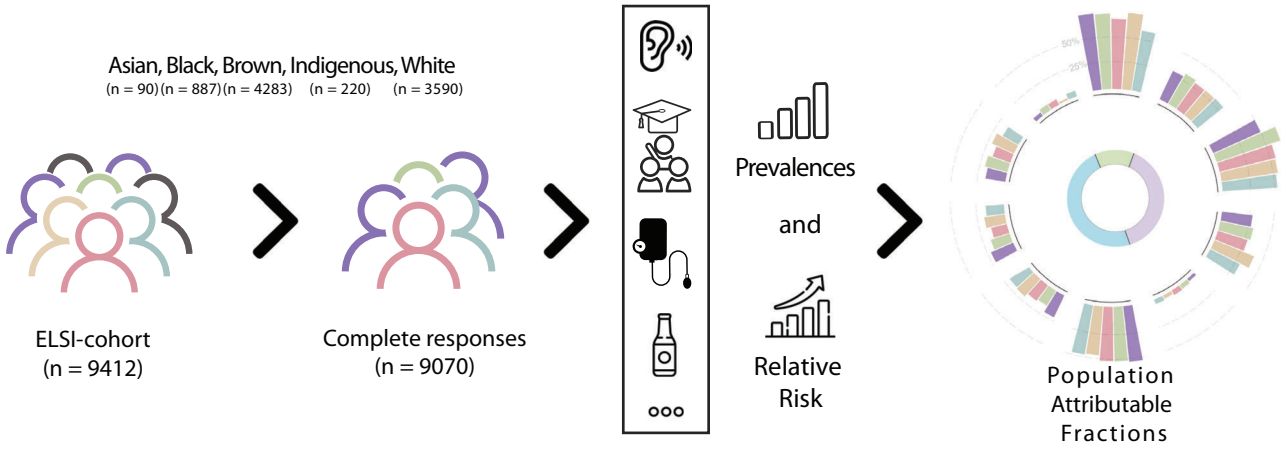

FIGURE 1 Schematic representation of the study design.

TABLE 1 Sociodemographic characteristics of this sample according to race.

	White ($n = 3590$)	Black ($n = 887$)	Brown ($n = 4283$)	Indigenous ($n = 220$)	Asian ($n = 90$)	*P*-value
Sex (M)	1552 (43.2%)	352 (39.7%)	1910 (44.6%)	97 (44.1%)	40 (44.4%)	0.11
Age, mean years (SD)	64.0 (± 10.2)	63.6 (± 10.2)	63.0 (± 10.0)	62.6 (± 9.6)	65.5 (± 10.8)	**<0.0001**
Education, mean years (SD)	6.2 (± 4.4)	4.7 (± 4.3)	5.0 (± 4.2)	4.3 (± 4.0)	4.6 (± 4.4)	**<0.0001**
Illiterates (%)	424 (27%)	357 (38.5%)	1433 (30.8%)	77 (31.6%)	33 (35.2%)	**<0.0001**
Urban zone (%)	3166 (88.2%)	736 (83.0%)	3528 (82.4%)	152 (69.1%)	73 (81.1%)	**<0.0001**
Minimum family wages mean (SD)	5.3 (± 3.8)	4.0 (± 2.5)	4.3 (± 2.8)	4.3 (± 3.0)	4.6 (± 2.9)	**<0.0001**
Region (%)						**<0.0001**
Midwest	303 (8.4%)	87 (9.8%)	487 (11.4%)	17 (7.7%)	10 (11.1%)	
North	113 (3.1%)	51 (5.7%)	482 (11.3%)	87 (39.5%)	7 (7.8%)	
Northeast	554 (15.4%)	321 (36.2%)	1548 (36.1%)	31 (14.1%)	27 (30.0%)	
South	918 (25.6%)	44 (5.0%)	274 (6.4%)	6 (2.7%)	7 (7.8%)	
Southeast	1702 (47.4%)	384 (43.3%)	1492 (34.8%)	79 (35.9%)	39 (43.3%)	

Note: $P < 0.0001$ in bold.
Abbreviation: SD, standard deviation.

2.2 | Variables collected

To identify the social, economic, and demographic characteristics of individuals of different races, we have selected several variables within the ELSI-Brazil cohort (Table S1 in supporting information). Races were self-reported according to the Brazilian Census, which was based on White, Black, Brown, Indigenous, and Asian[15] (Panel 1). Brown individuals are defined as any continuum between White and Black individuals, and comprehended as "Pardo," "Cafuzo," "Mixed," and others, as defined by the Brazilian Census.[15]

Ten modifiable risk factors for dementia were collected for this study, including lower educational attainment, hearing loss, hypertension, alcohol abuse, obesity, smoking, depression, social isolation, physical inactivity, and diabetes (Panel 1). Traumatic brain injury and air pollution were also previously mentioned as risk factors, but they were not collected in the ELSI-Brazil cohort.

2.3 | Statistical analysis

The PAF for each of the 10 risk factors was calculated according to a previously described methodology.[4] Unweighted PAF and weighted PAF (wPAF) values were calculated accounting for the communality of each risk factor within this sample. Sample weighting was possible due to the epidemiological approach of the ELSI-Brazil cohort, and the prevalence of each risk factor was estimated using the R package survey. Communality was adjusted due to the overlap between the prevalence of different risk factors, as mentioned previously.[16,17] The overall wPAF was composed of all 10 risk factors for each race.[2]

The formula to calculate PAF is based on the relative risk of dementia-associated risk factors and the prevalence of the same risk factor for each self-reported race. The prevalence was calculated based on a complex survey analysis, which also generated a 95% confidence interval. The meta-analytic relative risk for each risk factor was already

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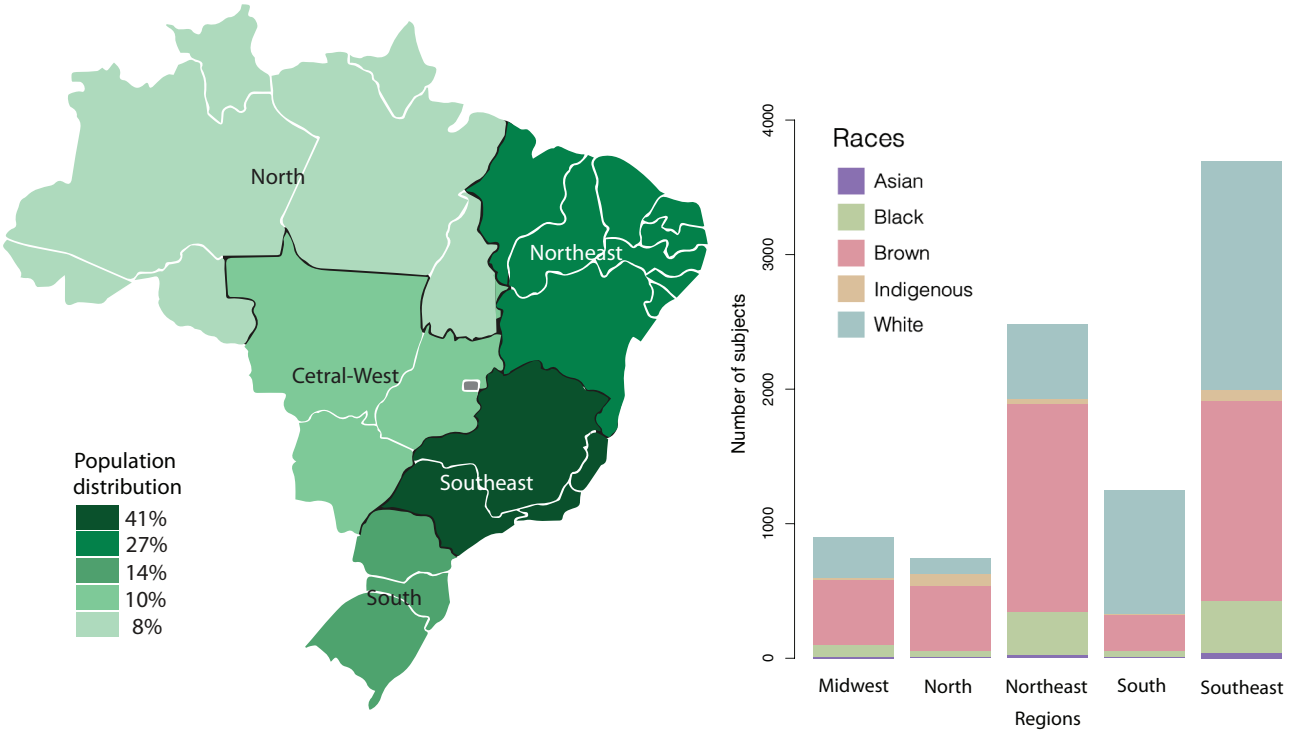

FIGURE 2 Racial and population distribution across Brazilian regions in the studied sample.

estimated using a previously described methodology.[17] Communality was also estimated to avoid misinterpretation of our results using principal component analysis, considering the sampling weights for each race and a tetrachoric correlation. For further information on the technique used, please refer to Mukadam et al.[17] All analyses were performed using R (V4.1.0) using built-in functions, the package *survey*, and *psych*.

3 | RESULTS

We included 9070 individuals that presented complete responses for the racial origin out of 9412 in the total cohort. Individuals included in this study presented a mean age of 63.46 (± 10.12) years, 5.42 (± 4.31) years of education, and were mostly women (5119, 56.4%). There were 4283 (47.2%) Brown individuals, 3590 (39.6%) White individuals, 887 (9.8%) Black individuals, 220 (2.4%) Indigenous individuals, and 90 (0.9%) Asian individuals (Figure S1 in supporting information). Racial distribution varied across regions (Figure 2).

Sociodemographic characteristics between races were highly variable (Table 1). Indigenous individuals presented a particularly distinct social profile compared to other races, such as younger age (62.6 ± 9.6), lower education (4.3 ± 4.0), and lower rates of urban living (69.1%). Black individuals showed lower family income (4 ± 2.5 minimum wages) and a higher rate of illiteracy compared to the others ($P < 0.001$; Table S2 in supporting information).

The profile of the PAF of the 10 risk factors for dementia varied widely among ethnicities (Table 2). The overall wPAF in Indigenous individuals accounted for 38.9%, 41.2% in Asian individuals; White, Black, and Brown individuals had similar PAFs (overall wPAF: 49.2%, 50%, and 50.1%, respectively).

Indigenous individuals presented the highest prevalence of low educational attainment (69.5%) and smoking (21%) in this study but a lower prevalence of physical inactivity (44.3%). Black individuals were characterized by a higher prevalence of hypertension (61%) and a lower prevalence of depression (15.8%; Figure 3). According to the sex-specific frequency of risk factors, males presented a higher frequency of alcohol abuse and smoking, while females presented higher rates of depression and cardiovascular risk factors, such as hypertension, obesity, and physical inactivity (Figure 4).

Besides the aforementioned risk factors, we also calculated the prevalence of poor sleep quality. Prevalence of poor sleep in Asian individuals reached almost half of the population (45.3%) while being lower in the other races (Black [27.8%], Brown [25.5%], White [23.5%], and Indigenous [24.3%]). Using a meta-analytic relative risk of 1.49 for poor sleep quality as a dementia risk factor,[18] the unweighted racial PAF was calculated according to racial estimates. Asian individuals presented the highest unweighted individual PAF for poor sleep quality (18.1%), while other races shared similar PAF (11.6 for Black, 11.3 for Brown, 10.5 for Indigenous, and 10.5 for White individuals).

4 | DISCUSSION

In this study we demonstrated race-related differences in the prevalence of major risk factors for dementia in Brazil. Indigenous and Asian

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TABLE 2 Weighted population attributable fraction associated with 10 risk factors.

	Relative risk for dementia	Asian individuals	Black individuals	Brown individuals	Indigenous individuals	White individuals
Less education	1.6	10	14.1	15.9	7.2	11.7
Hearing loss	1.9	13.4	15.2	15.2	16.7	15.2
Hypertension	1.6	2.5	7.8	9.8	5.9	9.4
Alcohol abuse	1.2	0.1	1.8	2	0	0.2
Obesity	1.6	1.9	5.4	6.1	1.6	7.1
Smoking	1.6	3.2	3.4	1.7	2.6	2.1
Depression	1.9	11.8	3.6	2.4	4.1	2.5
Low social contact	1.6	0.4	1.4	2.3	0.1	2.2
Physical inactivity	1.4	5.1	10.6	10.4	6.4	9.9
Diabetes	1.5	2.1	3.8	3.1	2	4
Overall weighted PAF		**41.2%**	**50%**	**50.1%**	**38.9%**	**49.2%**

Abbreviation: PAF, population attributable fraction.

PANEL 1 Race definition and detailed description of 10 risk factors for dementia collected within the ELSI-Brazil cohort.

Race definition
Self-related skin color, according to the Brazilian Census.
Less education
Less or equal to 4 years of education (similar to primary education in Brazil).
Self-reported education was collected.
Hearing loss
Self-reported hearing impairment.
Hypertension
Self-reported known diagnosis of hypertension given by a physician.
Heavy drinking
Self-reported drinking above 168 g of alcohol per week.
Obesity
Body mass index measured by the ELSI-Brazil team above 29. Height and weight were objectively measured.
Smoking
Self-reported smoking in later life.
Depression
Self-reported known diagnosis of depression given by a physician.
Physical inactivity
Self-reported less than 3 days a week of walking or any physical exercise.
Social isolation
Self-reported social contact frequency less than once per month with relatives or friends or outdoor group activities.
Diabetes
Self-reported known diagnosis of diabetes given by a physician.

individuals presented the lowest PAF, while Black, Brown, and White individuals showed similar PAF for modifiable risk factors for dementia. Each race showed a distinct profile of risk factor prevalence, except hearing loss, which was the highest risk factor among all races, highlighting itself as a possibility for population-wide policies targeting dementia. Three major points are discussed below: (1) risk factors shared by all races, (2) race-related PAFs, and (3) external validity of findings to the public health setting.

While both are social constructs that lack biological basis, race and ethnicity are distinct concepts that should be conceptualized to avoid misinterpretation of findings. In this study, race was defined in this study as self-reported skin color.[19] The US Census Bureau has decided that a single question to determine race and ethnicity was more suitable in epidemiological studies.[20] The Brazilian Census (IBGE) has also demonstrated the same method in determining an individual's identity,[15] using skin color as a determinant of race used in this study. In addition, ethnicity has historically been associated with cultural origins, geographically defined. According to an ethnological classification, most Brazilians are part of only one origin—Latino or Latinx—but ethnic differences in Brazil are varied because of its

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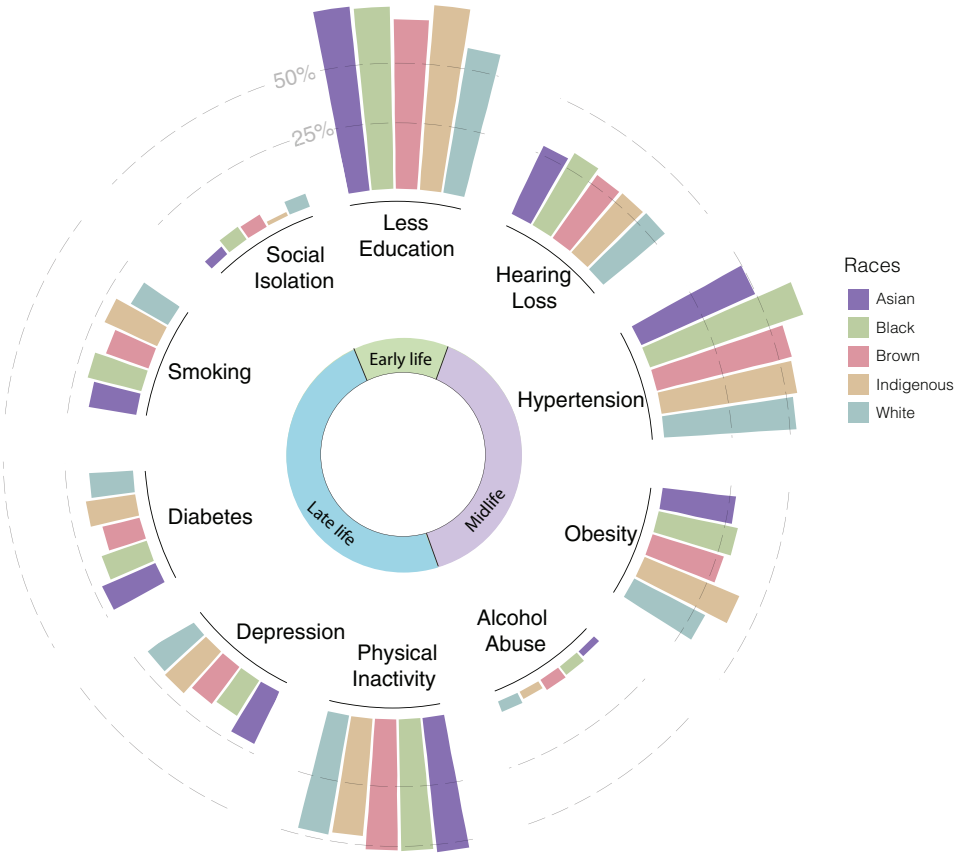

FIGURE 3 Prevalence of 10 modifiable risk factors of dementia according to race.

historical composition of a heterogeneous and multi-ethnic population from all around the globe.

The same three risk factors were the highest contributors to overall wPAF in the five racial origins analyzed—hearing loss, less education, and physical inactivity. Even though these risk factors were not the most prevalent, they appear to drive the total wPAF in this population. Additionally, our findings suggest that certain risk factors have a higher prevalence compared to the global population, in particular, cardiovascular risk factors—such as obesity (10 times), hypertension (5–6 times), and diabetes (almost 3 times). In contrast, alcohol and social isolation were extremely above the global prevalence average, reaching almost 10 times lower values.[2]

Hearing loss presented the highest weight on overall wPAF across all races. Weighted PAF contributed two times more to overall wPAF in this population compared to global figures. Self-reported hearing impairment was associated not only with dementia but also with accelerated multidomain cognitive decline and cognitive impairment.[21] Moreover, a recent meta-analysis demonstrated that hearing loss was independently associated with a higher incidence of Alzheimer's disease.[22] Our findings indicate that strategies to mitigate the negative impacts of hearing impairment might benefit all individuals studied. Clinical trials will be able to estimate the magnitude of change in the rate of incident dementia when hearing impairment is controlled.

Black and Brown individuals were characterized by risk factors related to socioeconomic inequality in this study, such as higher rates of illiteracy and low mean family income. Among other social determinants, these factors are traditionally associated with health inequalities, worse quality of life, and higher rates of mortality.[23] Social factors are directly and indirectly reflected in the wPAF of modifiable risk factors for dementia in Black individuals, such as high rates of less education, smoking, and physical inactivity. Hypertension prevalence was also increased in Black individuals, which corroborates a consolidated concept that Black individuals have higher rates of hypertension and that environmental and behavioral characteristics may trigger mechanisms of increased blood pressure in this population.[24]

Brown individuals composed the majority of the sample studied, which is representative of the Brazilian racial demographic data.[15] In this study, Brown individuals displayed a similar prevalence of risk factors compared to White and Black individuals. Less education had the highest wPAF among Brown individuals while hearing loss had the highest wPAF among other races. Currently, Brown individuals are studied among other races and ethnicities, such as "Hispanics" or "Latinos,"[25] which challenges the comparisons of this study. Note that all individuals within this population are defined are "Latinos."

Indigenous individuals presented a distinct profile of risk factors of dementia. The impact of 10 consolidated risk factors for dementia comprised only 38.9% of the weighted PAF for dementia. In our study, hearing loss, less education, and physical inactivity were the highest contributors to overall wPAF in Indigenous individuals. The overall wPAF of Indigenous individuals is lower than White, Black, and

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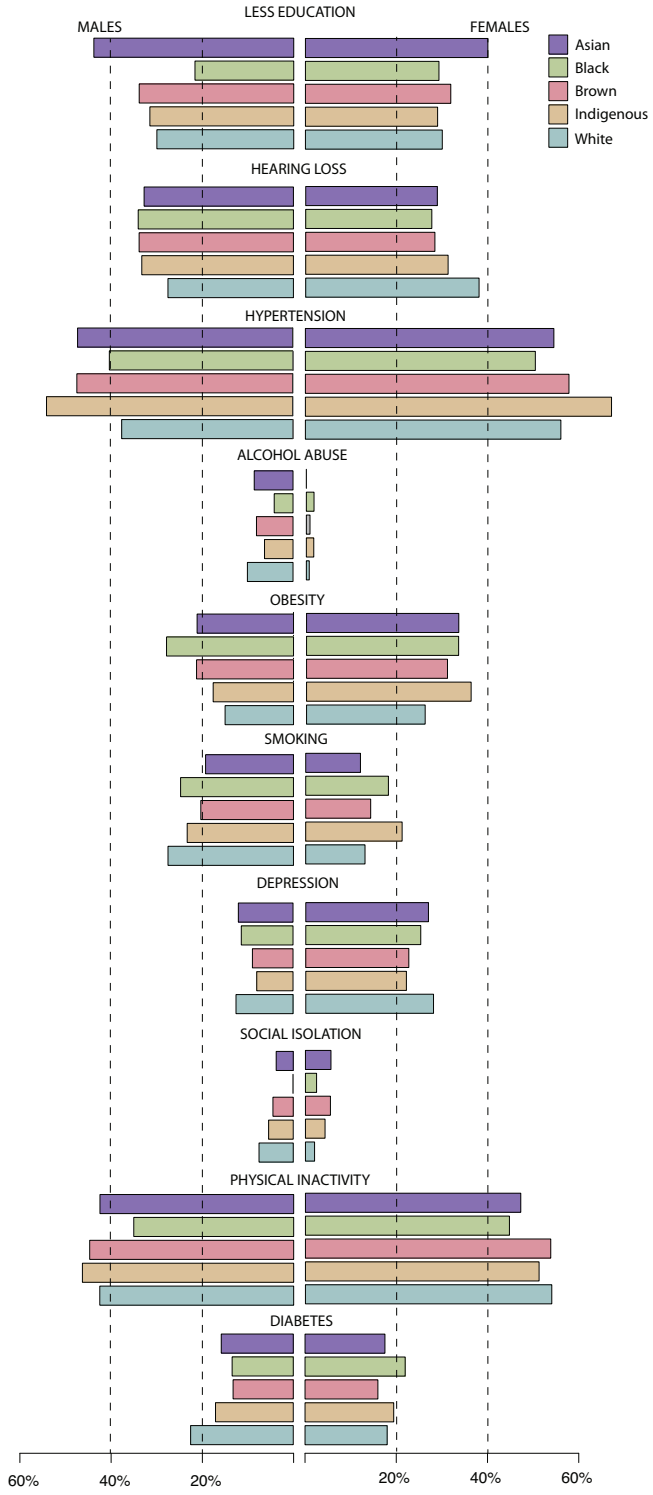

FIGURE 4 Sex-specific frequency of 10 modifiable risk factors for dementia according to race.

Brown individuals, but more similar to the Asian estimate, reported in a recent longitudinal analysis.[7] Globally, Indigenous people share some similarities, such as lower life expectancy and lower education.[26] This was a very similar pattern of wPAF and prevalence of modifiable risk factors to other races. Nevertheless, it diverges from other Indigenous populations, such as those in Canada and Australia, who have disproportionately high rates of cardiovascular disease among non-Indigenous[27,28] and Maori Indigenous from New Zealand, that presented obesity as the highest wPAF.[13] To explain such differences, other unidentified risk factors for dementia may play a major role in the Indigenous population. For example, a recent study estimated lower rates of mild cognitive impairment and dementia in two tribes of Indigenous individuals in the Bolivian Amazon, which they associate with a different lifestyle than the Western culture lifestyle.[29] In our study, treating hearing loss and weight gain early in Brazilian Indigenous people may be beneficial in reducing dementia incidence in the coming decades. Additionally, further investigations are pivotal to identifying the risk factor profile for dementia in local Indigenous individuals.

The PAF of Asian individuals in this study was similar to those described in the Asian population in New Zealand. In both studies, the PAF for these 10 risk factors is inferior to the overall fraction explained by these 10 risk factors comparable to the wPAF of other races.[13] The overall wPAF of Asian individuals was lower than that presented by other races. The incidence of dementia in Asia is similar to that in Europe,[8] with a higher proportion of vascular dementia than in European countries.[30] Similar to the Indigenous population, we hypothesize that other unmeasured factors may contribute to the incidence of dementia in these races. There are other risk factors described for Chinese individuals associated with dementia, such as rural residence, being widowed or divorced, and living alone.[31] For this reason, poor sleep quality was analyzed in this study, and findings exhibited that Asian individuals present a high prevalence of this risk factor. This reinforces the idea that other unidentified factors may have a higher impact on the Asian population. Further epidemiological investigations may elucidate the uncovered risk factors for dementia in the Asian population.

This research has practical implications for families and public health strategies. Primary care is the root of a public health system, and it plays a pivotal role in dementia prevention and screening. Race-related risk factors and their PAF should be personally addressed in patients from early ages, adapting interventions and public policies to each population. As presented previously, more than half of dementia cases in Brazil are preventable.[4,8] Race-related public health strategies should consider race-specific factors in the design of policies that aim to reduce the incidence of dementia in the coming decades. Strategies targeting sex differences are equally beneficial—in this study, males exhibit higher rates of substance abuse (alcohol and tobacco), while females present higher rates of depression and cardiovascular risk factors (hypertension, obesity, and physical inactivity). Black women may present faster cognitive decline compared to White men.[32] It is important to highlight that these findings were associated with 10 risk factors, while they have not fully addressed the increasing list of modifiable risk factors (which includes myriad social factors with an unclear relative risk for dementia, for example). Further studies should provide evidence on the relative risk of social determinants of health in dementia risk.[33]

Our study presents some limitations. The majority of risk factors retrieved in the ELSI-Brazil cohort were self-reported, which may be

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associated with an underestimation of prevalence due to memory bias.[34] To calculate the PAF of each risk factor, relative risks were retrieved from longitudinal cohorts and meta-analytic studies in different populations, which may potentially have discrepancies from the population studied;[2] however, there is very limited evidence of relative risk for risk factors in Brazil and other LMICs. In addition to the above-mentioned difficulty in defining race, self-reported responses are influenced by many factors, such as family perception of race, and social and cultural factors. This is especially important considering the characteristics of the Brazilian population. The majority of individuals in this study classified themselves as "Pardos," a category that encompasses a wide range of skin color, from white to black. Thus, many "Pardos" individuals are likely to have a skin color similar to those self-classified as White and/or Black. Despite these difficulties, knowledge of modifiable risk factors for dementia in this group is essential for coping with dementia globally. Moreover, this study may have underestimated depression in Asian individuals, as previous studies have indicated that this race reports fewer depressive symptoms than European individuals.[35] There is also a potential selection bias against Indigenous individuals living in urban areas. Rural areas present challenges in providing electricity and transport to the data acquisition team, which ultimately may impose a systematic selection of more urbanized populations. Finally, the original dataset did not include traumatic brain injury or air pollution, so these risk factors were not included in this study.

In sum, our findings warrant that public health interventions aiming to reduce preventable risk factors for dementia should take into consideration self-reported race of the target populations.

AUTHOR CONTRIBUTIONS

Wyllians Vendramini Borelli designed, drafted figures, performed the statistical analysis, and wrote the first and final versions of the manuscript. Carolina Rodrigues Formoso wrote the first draft of this manuscript, coordinated the data analysis and submitted its final version. Andrei Bieger drafted figures and wrote the final version of the manuscript. Pamela Lukasewicz Ferreira designed the concept of figures and reviewed the final version of the manuscript. Eduardo R. Zimmer designed and reviewed the final draft of the manuscript. Tharick Ali Pascoal designed and reviewed the final draft of the manuscript. Marcia Lorena Fagundes Chaves reviewed the final draft of the manuscript. Raphael Machado Castilhos designed the concept and analysis, and reviewed the final draft of the manuscript.

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CONFLICTS OF INTEREST

The authors declare they have no conflicts of interest. Author disclosures are available in the supporting information.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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