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How much the burden of diabetes and hypertension is attributable to social inequalities? An intersectional analysis in Brazil

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Abstract

Objective

This study aimed to analyze the association between the intersectionality of sex, race/skin color, educational attainment, and the occurrence of hypertension and/or diabetes mellitus among adults, using data from the 2023 Brazilian Vigitel National Survey.

Methods

A cross-sectional study was conducted using data from Vigitel 2023, which included 21,690 individuals aged ≥ 18 years. The outcomes were self-reported diabetes mellitus, hypertension, and the co-occurrence of both conditions. The exposures of interest were sex, race/skin color, and educational attainment. Analyses were guided by the "multiple jeopardy" framework (Jeopardy Index) to assess the intersectionality of these social markers.

Results

Black, Brown (mixed-race), Asian, and Indigenous women with low educational attainment had a four-fold higher risk of presenting with both conditions, a three-fold higher risk of diabetes, and a 2.3-fold higher risk of hypertension than that of white men with high educational attainment. Individuals with low educational attainment exhibited a higher prevalence of all assessed morbidities, regardless of sex, race, or skin color. It was estimated that 34.6%, 21.6%, and 44.2% of cases of diabetes, hypertension, and co-occurring diabetes/hypertension, respectively, were attributable to low educational attainment.

Conclusions

Social and racial markers of inequality are associated with the coexistence of diabetes and hypertension in Brazil. Low educational attainment emerged as a key social determinant of these conditions. Therefore, prevention and control strategies should incorporate actions aimed at addressing these structural vulnerabilities into public health policies.

Introduction

Noncommunicable diseases (NCDs), particularly hypertension and diabetes mellitus, are among the leading causes of morbidity and mortality worldwide (1). Of the 34.5 million deaths attributed to NCDs globally, 1.3 million were attributable to diabetes mellitus (2). According to the International Diabetes Federation (IDF), approximately 10.5% of adults will be living with diabetes in 2021, contributing to 6.7 million deaths in that same year (3). Hypertension is estimated to affect one in three adults worldwide (4).

In Brazil, approximately half of the older adult population is diagnosed with at least one of these conditions (5–7). Acute and chronic complications associated with hypertension and diabetes contribute to the pathogenesis of cardiovascular diseases, including coronary heart, cerebrovascular, and peripheral arterial diseases (8) leading to increased hospitalization, disability, and mortality (4, 8, 9).

Although these conditions represent a global public health challenge, their distribution is not uniform across the population. Studies conducted in countries such as the United States (10, 11), United Kingdom (12), and South Africa (13) have shown that Black individuals and those with lower educational attainment exhibit higher prevalence, poorer disease control, and greater risk of complications. However, analyses of how social determinants overlap and interact are limited (14–16).

Intersectionality has emerged as an analytical framework for examining the multiple and interacting axes of health inequality (17). This approach is essential for understanding the simultaneous forms of vulnerability that may remain obscured when social determinants are analyzed independently (18–20). In countries such as Brazil, where structural inequalities are deeply rooted, measuring the magnitude of disparities is particularly relevant to public health. Social markers significantly influence health outcomes and should be incorporated into policy implementation and health system management, particularly within the Sistema Único de Saúde (Unified Health System).

In this context, the present study aimed to analyze the association between the intersectionality of sex, race/skin color, educational attainment, and the occurrence of hypertension and/or diabetes among adults, using data from the 2023 National Vigitel Survey.

Methods

A cross-sectional study was conducted using data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel), collected in 2023 in Brazil (n = 21,690 adults). The Vigitel datasets are publicly available and can be accessed through the official website of the Ministério da Saúde. Vigitel is a telephone-based survey that monitors the frequency and distribution of major risk and protective factors for noncommunicable diseases (NCDs) among adults (≥ 18 years) residing in the 26 Brazilian state capitals and the Distrito Federal (21).

Vigitel uses a two-stage sampling design. First, a probabilistic sample of telephone lines is randomly selected from the registry provided by the Agência Nacional de Telecomunicações (Anatel). These lines are then randomly allocated to subsamples for each city. In the second stage, one adult resident of the selected household or the adult user of the selected mobile phone number, is invited to participate in the interview (21, 22).

Survey estimates were weighted using post-stratification weights to correct for unequal probabilities of selection (e.g., households with more than one adult or multiple telephone lines) and to align the sociodemographic distribution of respondents (by sex, age, and education) with the projected population distribution for each city and survey year. This was performed using the Rake method (22), based on census data and official population projections. Additional details regarding the sampling procedures, weighting processes, questionnaire used and evolution of Vigitel over time are described elsewhere (21, 22).

Self-reported physician diagnoses of diabetes mellitus and hypertension as well as sociodemographic characteristics were assessed. The outcomes, self-reported diabetes and hypertension, were defined based on affirmative responses to the following questions: “Has a doctor ever told you that you have diabetes?” and “Has a doctor ever told you that you have high blood pressure?” Both variables were dichotomous (yes or no). An additional outcome variable was created to identify individuals who reported concurrent diagnoses of diabetes and hypertension.

Sociodemographic variables included sex (male; female), race/skin color (White, Black, Asian, Brown [mixed race], Indigenous), age group (18–39; 40–59; ≥60 years), and educational attainment (0–8; 9–11; ≥12 completed years of schooling). These variables were subsequently combined to construct intersectional categories.

Analyses were guided by the "multiple jeopardy" framework (Jeopardy Index), an approach commonly used in intersectionality-based research to examine overlapping systems of social disadvantage. The multiple jeopardy model posits that distinct dimensions of identity such as sex, social class, and race, which are associated with discrimination or structural oppression, are interdependent and produce compounded or cumulative effects (23).

To construct the Jeopardy Index, the following exposure variables were included: sex (male, female), self-reported race/skin color (White; Black, Brown, Asian, or Indigenous), and educational attainment in completed years (0–8; 9–11; ≥12 years). The intersectionality of these sociodemographic markers was operationalized into five levels (0 to 4) based on the sum of the coded categories for each variable. Dichotomous variables were coded as 0 or 1, whereas variables in the three categories were coded as 0, 1, or 2. Within this framework, a score of 0 represented the most socially privileged group (white men with high educational attainment), whereas a score of 4 indicated the highest level of disadvantage (Black, Brown, Asian, or Indigenous women with low educational attainment).

All statistical analyses were performed using Stata version 15.0 (StataCorp LLC, College Station, TX, USA). The weighted prevalence and their respective 95% confidence intervals (95% CIs) were estimated for outcomes and exposure. Poisson regression models with robust variance were fitted for each exposure variable individually and for the multiple jeopardy index to estimate the crude and adjusted prevalence ratios (PRs) and 95% CIs, both for the overall sample and stratified by age group. In addition, the population-attributable fraction (PAF) of low educational attainment (defined as not completing high school) was calculated for diabetes, hypertension, and their coexistence.

Results

Among the 21,690 participants interviewed, the sample consisted predominantly of women (54.0%); individuals self-identifying as Black, Brown (mixed race), Asian, or Indigenous (60.2%); and those with 9–11 years of schooling (41.3%). According to the Jeopardy Index classification, White men with higher educational attainment represented 7.7% of the sample, whereas Black, Brown, Asian, and Indigenous women with lower educational attainment accounted for 10.6% (see Table 1).

Table 1
Absolute and relative description of the sample according to sociodemographic characteristics and Jeopardy index. Brazil, 2023 (N = 21,690).

Variables	**Sample** **N (%)**
Sex	
Male	8,132 (46.0)
Female	13,558 (54.0)
Race/skin color	
Caucasian	8,045 (39.8)
Black/Brown/Yellow/Indigenous	12,823 (60.2)
Education (years)	
0–8	5,520 (25.8)
9–11	8,099 (41.3)
12 or more	8,071 (32.9)
Jeopardy index	
0 (most privileged)	1,595 (7.7)
1	4,768 (22.8)
2	6,637 (31.8)
3	5,662 (27.1)
4 (less privileged)	2,206 (10.6)
*Relative numbers (%) were calculated using svy for sample weighting	
Figura 2. Prevalence of diabetes, hypertension, diabetes and hypertension according to Jeopardy index stratified by ages. Brazil, 2023 (N = 21,690).	

Figure 1 shows the prevalence of each outcome according to the vulnerability index. Overall, hypertension showed the highest prevalence, followed by diabetes, and then the co-occurrence of diabetes and hypertension. The highest prevalence was observed among Black, Brown, Asian, or Indigenous women with low educational attainment.

Age-stratified analyses (Fig. 2) indicated that individuals aged ≥ 60 years had the highest prevalence of all morbidities, particularly hypertension. The combined condition (diabetes and hypertension) also increased substantially with age, with the greatest burden observed among older adults in the most socially disadvantaged groups.

Figure 3 shows the prevalence of diabetes and hypertension and their coexistence according to sex and race/skin color within each educational stratum. Overall, individuals with low educational attainment exhibited a higher prevalence of all assessed morbidities, regardless of sex, race, or skin color. The highest prevalence of diabetes

(27.8%), hypertension (54.6%), and co-occurring diabetes/hypertension (22.4%) were observed among White women with low educational attainment. Among Black, Brown, Asian, and Indigenous women with low educational attainment, the prevalence of diabetes, hypertension, and both conditions was 18.9%, 51.1%, and 14.5%, respectively, compared to 6.3%, 22.1%, and 3.6% among White men with high educational attainment.

Table 2 presents the adjusted analysis of the outcomes according to sex, race/skin color, and educational attainment. Women had a higher prevalence of diabetes (PR = 1.21; 95% CI: 1.02; 1.45), hypertension (PR = 1.11; 95% CI: 1.01; 1.23), and co-occurring diabetes/hypertension (PR = 1.28; 95% CI: 1.02; 1.59) compared to that with men. Individuals with 0–8 years of schooling had a 3.7-fold higher prevalence of diabetes, a 2.43-fold higher prevalence of hypertension, and a 5.12-fold higher prevalence of co-occurring diabetes/hypertension compared to that of those with ≥ 12 years of schooling.

Table 2
Prevalence ratios and confidence intervals 95% of diabetes (DM), hypertension (HAS) and both diabetes and hypertension (DM AND HAS) according to sociodemographic variables and Jeopardy index. Brazil, 2023 (N = 21,690).

Variables	**DM**	**HAS**	**DM AND HAS**
Sex*			
Male	1.00	1.00	1.00
Female	1.21 (1.02; 1.45)	1.11 (1.01; 1.23)	1.28 (1.02; 1.59)
Race/skin color*			
Caucasian	1.00	1.00	1.00
Black/Brown/Yellow/Indigenous	0.76 (0.64; 0.91)	0.97 (0.88; 1.07)	.81 (0.66; 1.00)
Education (years)*			
0–8	3.70 (3.00; 4.56)	2.43 (2.16; 2.73)	5.12 (3.93; 6.68)
9–11	1.59 (1.27; 1.99)	1.30 (1.15; 1.48)	1.82 (1.35; 2.44)
12 or more	1.00	1.00	1.00
Jeopardy index			
0	1.00	1.00	1.00
1	0.90 (.62; 1.31)	0.83 (0.67; 1.04)	0.77 (0.47; 1.26)
2	1.43 (1.01; 2.01)	1.11 (0.90; 1.38)	1.64 (1.03; 2.62)
3	2.04 (1.46; 2.87)	1.49 (1.21; 1.83)	2.72 (1.72; 4.30)
4	3.02 (2.12; 4.30)	2.31 (1.85; 2.88)	4.01 (2.52; 6.37)
* Model: sex, race/skin color and education			

According to the intersectional analysis using the multiple jeopardy framework, Black, Brown, Asian, or Indigenous women had a 4-fold higher likelihood of presenting with both diabetes and hypertension, a 3-fold higher likelihood of diabetes, and a 2.3-fold higher likelihood of hypertension than that of White men with high educational attainment (Table 2).

The population attributable fraction analysis showed that 34.6% (95% CI: 23.7; 44.0) of diabetes cases, 21.6% (95% CI: 14.9; 27.8) of hypertension cases, and 44.2% (95% CI: 31.0; 54.9) of co-occurring diabetes/hypertension cases were attributable to low educational attainment (defined as not completing high school).

Discussion

This study found a higher prevalence of the investigated conditions—particularly hypertension—among individuals aged 60 years or older. Overall, low educational attainment was associated with a higher prevalence of diabetes and hypertension and their coexistence, regardless of sex, race, or skin color. Notably, the prevalence was higher in women than in men. Furthermore, Black, Brown (mixed race), Asian, and Indigenous women had a 4-fold higher likelihood of presenting with both diabetes and hypertension, a 3-fold higher likelihood of diabetes, and a 2.3-fold higher likelihood of hypertension compared to that of White men with higher educational attainment.

In the present analysis, women showed a higher prevalence of diabetes, hypertension, and their coexistence than that of White men with higher educational levels. Evidence suggests that men tend to use primary healthcare services less frequently than women, which may contribute to differences in diagnostic patterns (24–26). Lower male engagement with health services has been associated with socially constructed gender roles that emphasize strength, the provider role, and denial of vulnerability (27), as well as feelings of omission, denial, and concealment of health needs (28). Men are also more likely to seek care only when the disease is already advanced rather than for preventive services (29). These behavioral patterns may partially explain the sex differences in self-reported diagnoses.

When stratified by educational attainment, our findings showed a higher occurrence of the studied morbidities among White women with low education levels, whereas race/skin color alone demonstrated a weaker independent association. These results suggest that sex and educational attainment may be influential determinants of the development of diabetes and hypertension. A study conducted among rural African-American women in the United States found that lower educational attainment was associated with higher cardiovascular risk, regardless of race (30). Similarly, Black women with lower education were more likely to have hypertension prevalence exceeding 70% compared to that of younger or more educated groups (31).

Educational disparities in the prevalence of hypertension and diabetes in the United States have been shown to persist even after adjusting for age and body mass index. Among women, those with less than a high school education had a 1.32- to 3.95-fold higher prevalence of diabetes across all age groups (32). The systematic and structural disadvantages faced by racial and ethnic minority groups, such as lower income and reduced access to health services, have also been associated with an increased risk of diabetes and hypertension among Black women with lower educational attainment. Krishnan et al. (2010) reported that Black women with ≤ 12 years of schooling had a 28% higher incidence of diabetes compared to that of those with ≥ 17 years of schooling, and that women with annual household incomes below US$15,000 had a 57% higher diabetes risk compared to that of those earning above US$100,000. Additionally, neighborhood socioeconomic status further amplified these risks, with women living in the lowest quintile experiencing a 65% higher diabetes incidence (33).

Analyses based on data from the National Health and Nutrition Examination Survey (NHANES) also demonstrated that Black individuals had a higher probability of diabetes compared to that of White individuals, and that individual poverty and residence in economically deprived neighborhoods increased the likelihood of diabetes among both groups (34).

Low educational attainment was consistently identified as a risk factor in both conditions. In Austria, lower educational levels have been associated with an increased risk of hypertension and diabetes among women, with the highest rates observed among those with the lowest educational levels (35). In Brazil, Malta et al. (2022) reported a higher self-reported prevalence of diabetes among women than among men, and among individuals with lower education (7). Based on the population attributable fraction estimated in our study, approximately 5.6 million diabetes cases and 9.8 million hypertension cases in Brazil could be attributed to low educational attainment, underscoring the substantial impact of educational inequality on NCDs.

Regarding intersectionality, the findings of Silva et al. (2023) align with our results, indicating that Black women and men have a higher risk of hypertension than that of White men, who represent the least vulnerable group (36). These findings highlight how the intersection of sex and race/skin color contributes to inequalities in the occurrence of chronic diseases. An intersectional approach also demonstrated that the prevalence of uncontrolled blood pressure is higher among Black women than among White men and women (37). Vieira et al. (2025) further observed that Black individuals and those with lower educational attainment had lower levels of knowledge regarding hypertension control (38).

Multiple factors contribute to the management of hypertension and diabetes, including key social determinants of health such as health literacy, socioeconomic status, access to health services, awareness levels, and dietary patterns (39). Disparities in disease control may also reflect reduced access to care, lower income, and structural barriers that disproportionately affect women, particularly Black women. A study conducted in South Korea found that individuals with both high education and income had a significantly lower probability of presenting with diabetes and hypertension across models, whereas discordant socioeconomic indicators (high education/low income or low education/high income) were differentially associated with disease presence (40).

Age-stratified analyses revealed that individuals aged 60 years or older had the highest prevalence of diabetes, hypertension, and their coexistence. Multimorbidity affects more than half of the older adults and increases progressively with age, particularly among the oldest age groups. A higher prevalence of multimorbidity has been observed among individuals with lower socioeconomic status and women (41).

This study has some limitations. The broad categorization of race/skin color (grouping Black, Brown, Asian, and Indigenous individuals) was necessary for statistical modeling but may have reduced analytical sensitivity by obscuring heterogeneity between groups. However, this study has several strengths. It uses data from the 2023 Vigitel Survey, a nationally representative, population-based telephone survey with a standardized methodology, ensuring broad coverage, comparability with prior studies, and relevance to public health policy. A large, representative sample would allow for statistically robust estimates. Moreover, the use of an intersectional framework provides a more comprehensive understanding of social health inequalities.

Conclusion

In this study, the intersection of sex, race/skin color, and educational attainment was directly associated with NCDs. Black women with low educational attainment concentrated on multiple overlapping vulnerabilities, as reflected by a higher prevalence of hypertension and diabetes mellitus, both individually and concomitantly. Conversely, from an intersectional perspective, the combination of male sex, white race/skin color, and higher educational attainment has historically functioned as a protective social position, reflecting greater access to resources, health services, and more favorable conditions for the prevention and control of NCDs.

These findings reinforce the idea that health inequities cannot be understood in isolation but rather as the result of intersecting social markers that structure access to resources, information, and healthcare. Therefore, public policies and prevention strategies targeting NCDs should incorporate an intersectional approach that prioritizes historically marginalized groups. Actions should focus on reducing the modifiable risk factors, expanding equitable access to health services, and promoting health equity.

Overall, hypertension showed the highest prevalence, followed by diabetes and the coexistence of both conditions, particularly among Black, Brown (mixed race), Asian, and Indigenous women with low educational attainment. When examining the intersection of female sex, Black race/skin color, and low education, a cumulative pattern of vulnerability becomes evident, intensifying the risk and resulting in a higher burden of noncommunicable diseases.

In this context, being a White male appeared to function as a protective factor only among those with high educational attainment. These inequalities underscore the urgent need to implement public policies aimed at reducing modifiable risk factors and addressing structural determinants to promote effective prevention and control of NCDs, especially among socially vulnerable populations.

Declarations

Ethics approval and consent to participate

The data is public and was used for research purposes, respecting ethical principles and the confidentiality of information provided by respondents.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Author Contribution

R.G.N. performed the statistical analyses. R.G.N, N.G.R.M., B.L.B. and L.P.M. wrote all sections of the article and worked on the literature review. R.B., E.S.S. and M.O.S. critically reviewed the entire manuscript. All authors approved this version of the manuscript.

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Data Availability

The data used is open access and available in a database of the Brazilian Ministry of Health.

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Figures

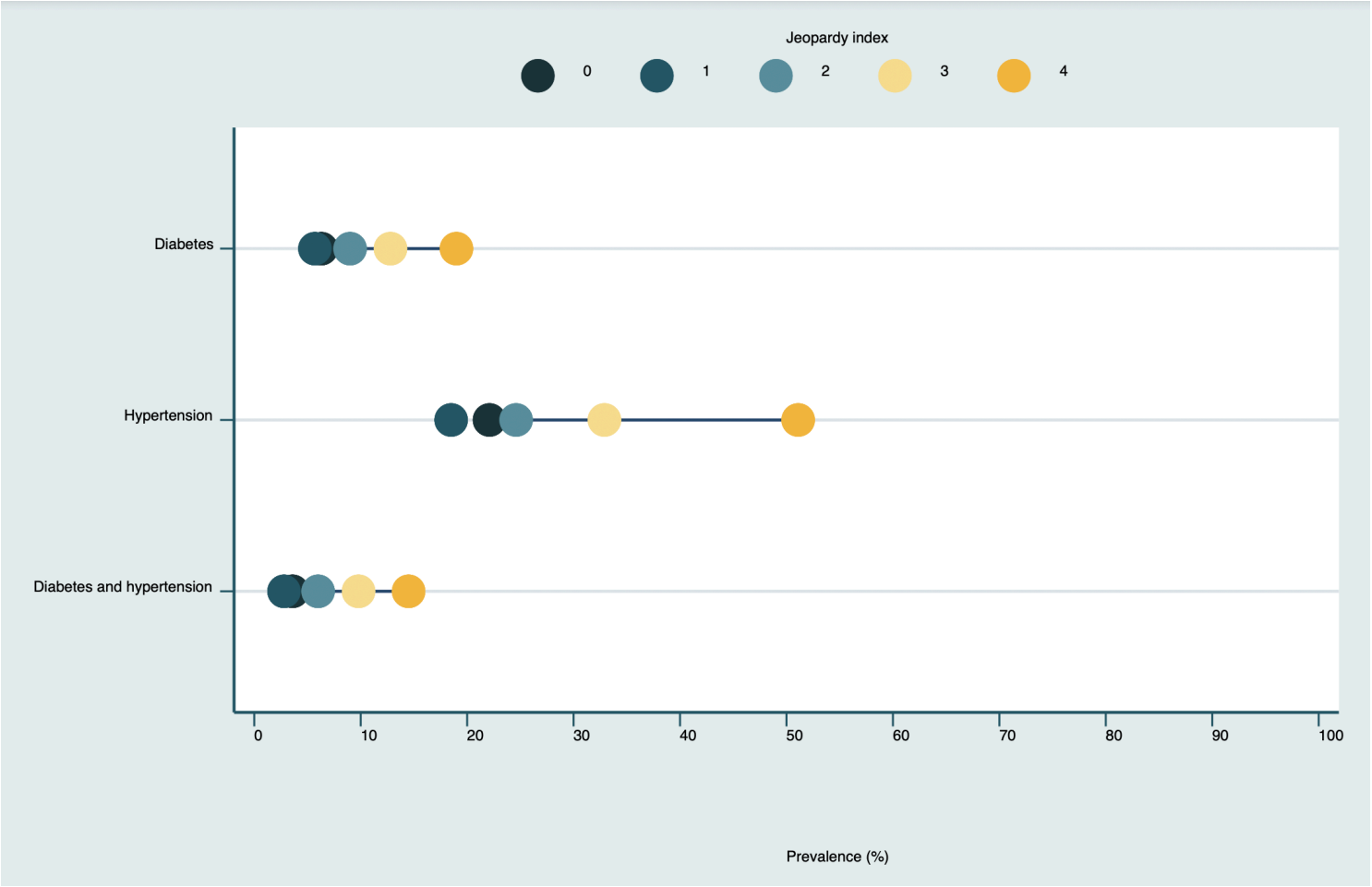


Figure 1

Prevalence of diabetes, hypertension, diabetes and hypertension according to Jeopardy index. Brazil, 2023 (N=21,690).

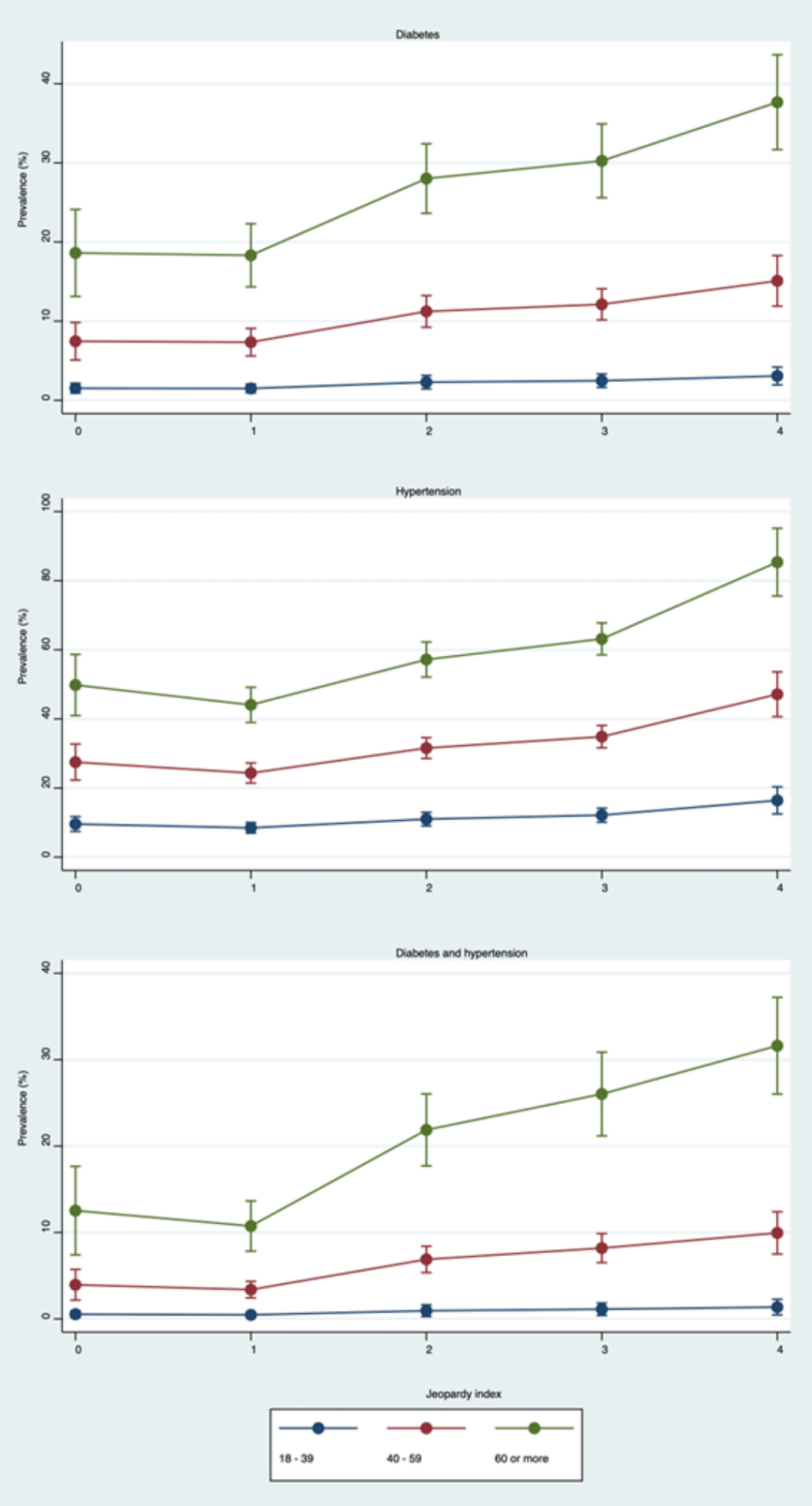


Figure 2

Prevalence of diabetes, hypertension, diabetes and hypertension according to Jeopardy index stratified by ages. Brazil, 2023 (N=21,690).

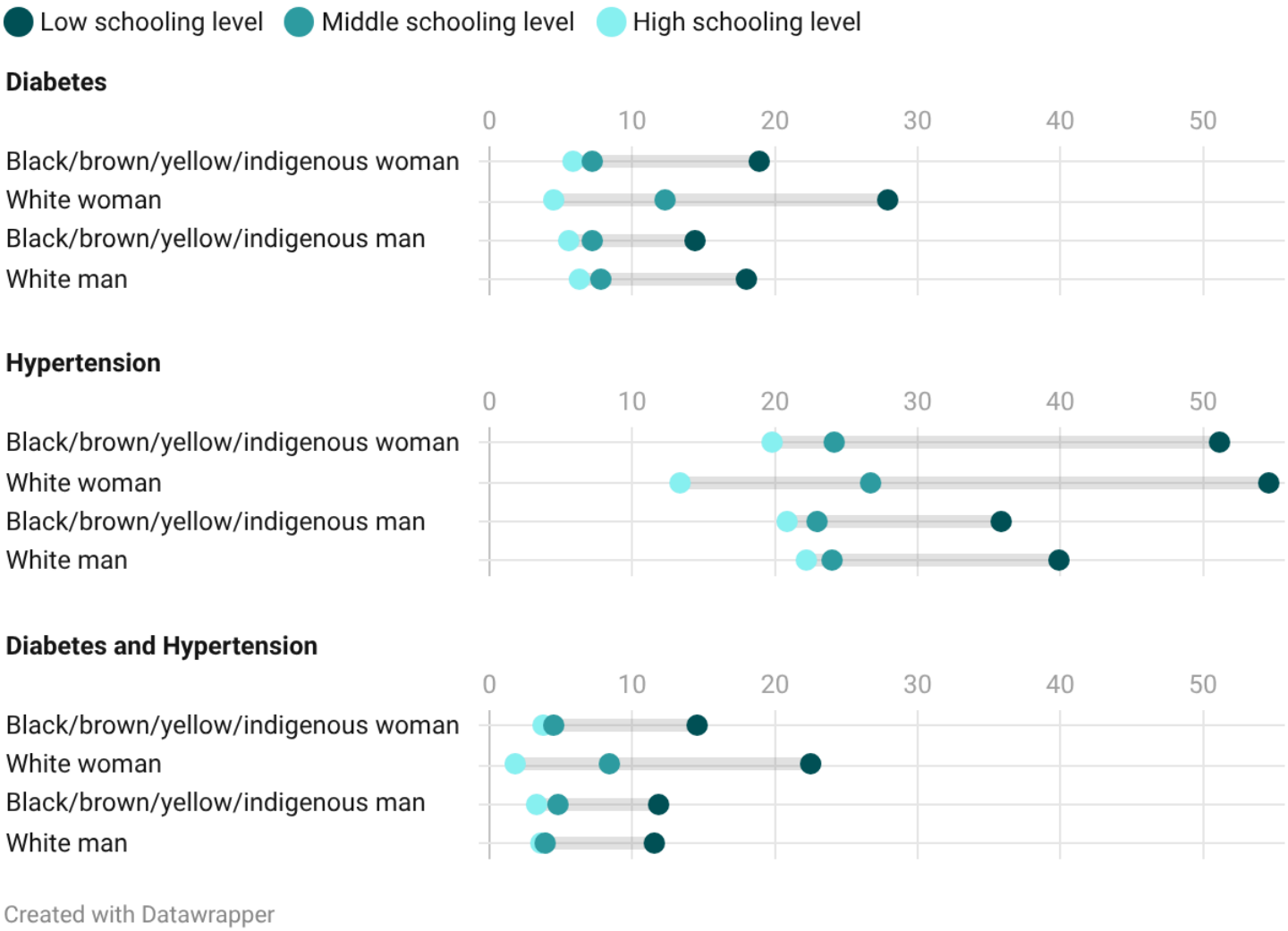


Figure 3

Prevalence of diabetes, hypertension, diabetes and hypertension according to demographic characteristics stratified by education. Brazil, 2023 (N=21,690).