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Diabetes Prevalence and Incidence Inequality Trends Among US Adults, 2008–2021

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Abstract

Introduction: This study examined national trends in age, sex, racial and ethnic, and socioeconomic inequalities for diagnosed diabetes prevalence and incidence among US adults from 2008–2021.

Methods: Adults (≥18 years) were from the National Health Interview Survey (2008–2021). The annual between-group variance (BGV) for sex, race, and ethnicity, and the slope index of inequality (SII) for age, education, and poverty-to-income ratio (PIR) along with the average annual percent change (AAPC) were estimated in 2023 to assess trends in inequalities over time in diabetes prevalence and incidence. For BGV and SII, a value of 0 represents no inequality while a value further from 0 represents greater inequality.

Results: On average over time, PIR inequalities in diabetes prevalence worsened (SII: −8.24 in 2008 and −9.80 in 2021; AAPC for SII: −1.90%, p=0.003) while inequalities in incidence for age (SII: 17.60 in 2008 and 8.85 in 2021; AAPC for SII: −6.47%, p<0.001), sex (BGV: 0.09 in 2008, 2.05 in 2009, 1.24 in 2010, and 0.27 in 2021; AAPC for BGV: −12.34%, p=0.002), racial and ethnic (BGV: 4.80 in 2008 and 2.17 in 2021; AAPC for BGV: −10.59%, p=0.010), and education (SII: −9.89 in 2008 and −2.20 in 2021; AAPC for SII: 8.27%, p=0.001) groups improved.

Conclusions: From 2008–2021, age, sex, racial and ethnic, and education inequalities in the incidence of diagnosed diabetes improved but persisted. Income-related diabetes prevalence inequalities worsened over time. To close these gaps, future research could focus on identifying factors driving these trends including the contribution of morbidity and mortality.

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INTRODUCTION

Diverging overall trends in diabetes prevalence and incidence among US adults have been documented over the past 12 years.[1] While prevalence increased from 1990–2009 and has since plateaued, incidence also reached a peak between 2008 and 2009 but has gradually declined into 2019.[2, 3] Significant age, sex, racial and ethnic, and socioeconomic inequalities in diabetes prevalence and incidence have been documented in the US with a higher concentration of diabetes among men, adults aged 45 and older, people from racial and ethnic minority groups, and lower socioeconomic groups; however changes in these inequalities after the 2008 peak are not well understood.[3–5] There have been significant historical events since 2008 that may have affected trends in inequalities in diabetes prevalence and incidence. For instance, the enactment of the 2010 Affordable Care Act (ACA), may have improved access to diabetes preventive care. In addition, the COVID-19 pandemic may have led to higher hospitalization and mortality among racial and ethnic minority groups and communities with low incomes, with and without diabetes.[6–9] Thus, this study examined national trends in disparities for US adults during 2008–2021 by age, race and ethnicity, sex, and socioeconomic status (education and family income-poverty ratio) to further understand changing diabetes patterns among traditionally marginalized populations and to enhance monitoring of diabetes disparities.

METHODS

Study Sample

The National Health Interview Survey (NHIS) is a nationally representative, cross-sectional household survey of the civilian non-institutionalized US population that has been conducted since 1957 by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS). Interviews are conducted at the respondents' home or via telephone. All information is self-reported. All respondents gave oral consent, and all personally identifiable information was removed before the data were released. NHIS had a major questionnaire redesign and updated weighting adjustments in 2019. In 2020, NHIS shifted from in-person to all-telephone interviewing starting in late March due to the COVID-19 pandemic. Some in-person interviewing resumed in July 2020 in selected areas with low COVID-19 incidence until May 2021 when interviewers returned to regular survey interviewing procedures. Detailed information about the survey methods has been described elsewhere. [10] The study population comprised 427,368 adult respondents (≥18 years of age) with complete information on self-reported diagnosed diabetes status from the 2008–2021 NHIS with analyses conducted in 2023. NHIS is approved by the Research Ethics Review Board of the NCHS.

Measures

Diagnosed diabetes was defined based on answering yes to the question '[(If female), Other than during pregnancy] Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?'. Respondents with diagnosed diabetes were asked to report their age at diagnosis. Diabetes prevalence was estimated as the proportion of adults who reported having diagnosed diabetes in the total sample for each year. Based on prior methods, incident cases were ascertained by subtracting the respondent age at the interview from reported age of diabetes diagnosis. [2] Respondents with the same age and age of diabetes diagnosis were considered incident cases. To account for those who had a birthday during the first year of diagnosis, half of those with an age one year greater than the age of diabetes diagnosis were included as incident cases. Incidence for each year was estimated by dividing the number of incident cases by the total adult sample after excluding those diagnosed with diabetes for more than a year.

Age and sex were self-reported. Age was categorized as 18–44, 45–64, and ≥65 years. Sex was categorized as female and male.

Self-identified race and Hispanic ethnicity was combined to create the following analytical categories: Hispanic, non-Hispanic Asian (NH Asian), non-Hispanic Black (NH Black), and non-Hispanic White (NH White). The Other category included individuals of mixed race or ethnicity, non-Hispanic American Indian/Alaska Native adults, and Pacific Islander adults, but was excluded from analyses on race and ethnicity due to limited sample size (n=10,374).

Socioeconomic status (SES) measures included education and family poverty-to-income ratio (PIR). Education was categorized as <high school, high school diploma/GED, some college/associates degree, or bachelor's degree and higher. NCHS imputed missing income data (range 19–30%) using multiple imputation for each year. The ratio of family income to the applicable federal poverty thresholds were calculated based on the imputed income values. The poverty threshold was based on family size, the number of children and a person aged 66 years or older with the threshold dollar amounts being adjusted each year. A more detailed discussion of the imputation procedure has been published elsewhere.[11] PIR was categorized as <1.0, 1.0–2.9, 3.0–4.9, and ≥5.0 based on the distribution of the data.

The Health Disparities Calculator (HD*Calc) software, developed by the National Cancer Institute and McGill University, was used to measure health disparities.[12] This tool facilitates calculating the between-group variance (BGV) and slope index of inequality (SII) as the absolute measures of inequality in diagnosed diabetes prevalence and incidence among US adults.

The BGV summarizes squared deviations from a population average. The BGV can be interpreted as the variance that would exist if each individual had the mean probability of diabetes of their social group.[13, 14] The BGV is weighted based on population size and is sensitive to the magnitude of large deviations from the population average.[13, 14] This index is recommended for comparison across multiple unordered groups (e.g., race and ethnicity, and sex).[13, 14] In addition, as described previously, the BGV is the preferred measure for assessing racial and ethnic inequalities as it uses the population mean as the reference group, rather than a specific subgroup.[15] This is important as it prevents stigmatizing or idealizing certain subgroups. A value of 0 represents no inequality while a value further from 0 represents greater inequality. The formula to calculate BGV is described in the Methods of the Appendix and published elsewhere.[13, 14]

The SII is used for social groups with implicit ranking (e.g., age, education, and income) and to measure the average health status between the most advantaged and disadvantaged group while accounting for all other subgroups.[13, 14] In this study, it represents the difference in diabetes prevalence or incidence between the most advantaged and disadvantaged groups. A value of 0 indicates no inequality while a more negative value represents a larger concentration of diabetes in the most disadvantaged group. The formulas to estimate the SII are described in the Methods of the Supplement and published previously.[13, 14]

Statistical Analysis

The sociodemographic distribution of the US adult population from 2008–2021 was calculated and compared over time using the Cochran-Mantel-Haenszel (CMH) test for trend for nominal characteristics and the ANOVA-type CMH test for ordinal characteristics. In addition, the age-standardized prevalence and incidence of diagnosed diabetes for each age, sex, race and ethnicity, education, and PIR group were estimated. Age-standardization was based on the 2010 US census using the age groups 18–44, 45–64, and ≥65 years of age. These analyses were conducted using SAS-Callable SUDAAN v11.0.1 to account for the complex survey design of NHIS. [16] Results were exported to HD*Calc to calculate the annual BGV and SII for both prevalence and incidence. [12] These results were then imported into Joinpoint Regression Program v4.9.1.0 to calculate the average annual percentage change (AAPC) and 95% confidence intervals (CI) based on log-linear models for the prevalence and incidence of each age, sex, race and ethnicity, education, PIR group as well as BGV and SII. [17] This method was used to characterize and evaluate prevalence and incidence trends across groups and overall trends in inequalities.[18–20] The number of inflection points was constrained to zero to focus the analysis on overall trends during 2008–2021. The magnitude, direction, and statistical significance of trends were assessed at the p <0.05 level.

RESULTS

Over time from 2008–2021, the US population became older (adults ≥65 years increased), more racially and ethnically diverse, and had greater education and PIR (p <0.001) (see Appendix Table 1). There were no statistically significant changes in the sex distribution over time (p=0.96).

Between 2008 and 2021, there were no statistically significant overall changes in diabetes prevalence while incidence declined over time (AAPC −3.33%; p<0.001) (see Figure 1 and Appendix Table 2). Diabetes prevalence and incidence trends across age, sex, education, PIR, and race and ethnicity are shown in Figure 2 and Appendix Table 2. Diabetes prevalence did not significantly change across age groups, while incidence significantly declined over time for those 45–64 (AAPC −3.28%; p<0.001) and ≥65 (AAPC −5.12%; p<0.001) years of age. Also, no significant changes by sex were found for diabetes prevalence while the incidence declined for both female (AAPC −4.02%; p<0.001) and male individuals (AAPC −2.67%; p<0.001). Across racial and ethnic groups, diabetes prevalence did not significantly change except for NH Asian adults who had significant increases in diabetes prevalence (AAPC 0.96%; p=0.042). Diabetes incidence significantly decreased over time for Hispanic (AAPC −4.78%; p<0.001), NH Black (AAPC −3.66%; p=0.025) and NH White (AAPC −3.54%; p=0.001) adults but did not significantly change for NH Asian adults. Diabetes prevalence significantly increased over time for those with < high school education (AAPC 0.60%; p=0.006) and those with some college/associates degree (AAPC; 0.76%; p=0.031) while diabetes incidence significantly decreased across all education groups. Diabetes prevalence significantly increased over time for those with a PIR of <1.0 (AAPC 1.13%; p=0.026) while the prevalence did not significantly change over time for other PIR groups. The incidence significantly decreased over time nearly across all PIR groups, except those with a PIR of 1.0–2.9 for whom the trend was not statistically significant.

Table 1 shows the BGV and SII across all years of the study period and the AAPC for these inequality measures for diabetes prevalence and incidence. Trends in BGV and SII plotted over time are shown in Figure 3. Based on the overall BGV, there were significant overall racial and ethnic inequalities in diabetes prevalence and incidence during 2008–2021 while sex inequalities were only statistically significant for prevalence. The positive SII value for age group indicates greater diabetes prevalence and incidence among the older age groups, while the negative SII values for both the education and PIR diabetes prevalence and incidence suggest a higher concentration of diabetes prevalence and incidence among the lower education and PIR groups. Significant worsening inequality trends for diabetes prevalence was found for PIR (AAPC 1.90%; p=0.003), but there were no statistically significant changes for age, race and ethnicity, sex, and education. In contrast, improving inequality trends for diabetes incidence was found for age (AAPC −6.47%; p<0.001), education (AAPC 8.27%; p=0.001), sex (AAPC −12.34%; p=0.002), and race and ethnicity (AAPC −10.59%; p=0.010). No statistically significant changes in incidence were observed for PIR.

DISCUSSION

Although age, sex, racial and ethnic, and SES inequalities in diagnosed diabetes prevalence and incidence persisted during 2008–2021, differing trends were observed in these inequalities over time. During 2008–2021, age, sex, racial and ethnic, and education inequalities in diagnosed diabetes prevalence did not significantly change, but incidence inequalities improved over time. Income-related inequalities in diagnosed diabetes prevalence worsened over time while no significant changes were found for incidence inequalities.

The improving age inequalities in diagnosed diabetes incidence may be primarily driven by the decline in incidence over time among those aged 45–64 and ≥65 years. Saturation may have led to the decline in the rate of newly diagnosed diabetes among these age groups. Increased screening efforts combined with implementing a lowered threshold in 1997 for fasting glucose resulted in most of the at-risk population being captured (i.e., depleting susceptible population by reducing the number of undiagnosed diabetes cases); subsequently incidence of diagnosed diabetes decreased over time. [21] The changes in recommendation in 2022 by the American Diabetes Association to screen all patients ≥35 years of age and the 2021 recommendation by the USPSTF to screen all asymptomatic adults aged 35–70 years who have overweight or obesity may increase the incidence of diagnosed diabetes among younger age groups in the upcoming years not captured in this study. It may be important for future studies to monitor how these recent changes in recommendations could affect the trends in age inequalities.[22, 23]

A prior study examining national trends in prevalence and incidence using NHIS generally found no significant trends in prevalence by age, sex, race and ethnicity, and education except an increasing prevalence trend among those with > high school education; the study found declines in incidence only among those with a high school education and NH White adults from 2008–2017.[2] This study also found no significant trends across age and sex groups, but observed significant increasing trends in prevalence for those with < high school education and some college or an associate's degree, and for NH Asian adults from 2008–2021. In contrast to the previous study, this study found significant declining trends in incidence during 2008–2021 among those 45–64 and 65–70 years of age, and generally across all sex, education, and racial and ethnic groups; however, there were no significant trends in incidence for NH Asian adults. The contrasting findings in trends between studies may be due to the prior study including data through 2017 while this study included newer data from 2008–2021. In addition, another study comparing disparities in diagnosed diabetes prevalence between two time periods, 1999–2002 to 2011–2014, found that the overall education and PIR prevalence disparities increased over time.[24] The differing results may be due to the two studies use of different methodology and time periods.

An important factor which may explain the declining racial and ethnic, and education inequalities in diabetes incidence could be the faster rate of decline in diabetes incidence among historically disadvantaged groups compared to the more advantaged groups (e.g., NH White adults and those with a bachelor's degree or higher). The decline in diabetes incidence among these disadvantaged groups may be partly due to the passage of the ACA that increased access and use of healthcare by racial and ethnic minority groups and lower SES groups, which may be important for diabetes prevention.[6, 8, 9] Conversely, there has also been an increase in use of high deductible health plans (HDHPs) among privately insured populations which may have led to decreased healthcare visits and thus decreased screening and lower case detection among this population.[25] Use of HDHPs have increased across all privately insured racial and ethnic and income groups. However, health savings accounts, which help pay for care in HDHPs, are less used by disadvantaged populations which makes these populations more vulnerable to suboptimal care.[26] Furthermore, these declines in inequalities may be explained by saturation in which racial and ethnic minority and lower education groups have a larger susceptible population of undiagnosed diabetes in earlier years, allowing for greater decline in incidence over time.[21] Expanding access to lifestyle change interventions such as CDC's National Diabetes Prevention Program that also focuses on racial and ethnic minority and lower SES groups, may be particularly important in helping to reduce type 2 diabetes risk factors, given that previous studies found lower participation of these groups.[27–29]

These findings of an increasing prevalence trend only among those with a family income below the federal poverty level may be explained by their decline in diabetes mortality.[30] As described in prior studies, diabetes prevalence will continue to rise if the decline in mortality rate is greater than the decrease in incident cases.[31] Although there may have been lag time between Medicaid expansion in 2014 and the observed prevalence, the expansion may partially explain the reductions in diabetes related mortality for lower income groups as it increased health insurance coverage allowing greater access to diabetes care.[32, 33] Furthermore, interventions to improve obesity and physical activity may be important as a previous study found that these modifiable factors were major contributors to income-related diabetes prevalence inequalities.[34] Future studies could examine whether policy interventions (e.g., universal basic income and increasing minimum wage) to reduce income inequalities affect diabetes incidence and prevalence given that some research suggests these policies benefit health.[35,36]

Limitations

There are several limitations to consider. First, diagnosed diabetes was self-reported in NHIS which may have resulted in underreporting of diabetes and underestimating the prevalence and incidence. Second, the self-reported questionnaire did not distinguish between type 1 from type 2 diabetes until 2016 which prevented this study from examining trends by diabetes type. Third, small sample sizes prevented this study from examining differences across other racial and ethnic groups and more granular groupings (e.g., within male and female). Fourth, this study was unable to determine whether individual-level factors (e.g., delays in diagnosis) contributed to observed inequalities in diagnosed diabetes. Finally, changes in diabetes prevalence and incidence after 2018 may be due to the questionnaire redesign and weighting adjustments implemented in 2019 and not actual changes.

A major strength of this study was the large nationally representative sample of the non-institutionalized, US civilian population with data spanning over a decade. In addition, this is one of few studies to use inequality summary measures to examine trends in diagnosed diabetes inequalities among age, sex, racial and ethnic, and SES groups. The advantage of using these summary measures to monitor inequalities over time, instead of pairwise comparisons, is that they account for changes in population size of each subgroup over time.[13] Another strength of using summary measures was the ease of communication by summarizing the inequalities across subgroups with a single value. This may be particularly important for communicating results to stakeholders with limited knowledge on data (e.g., policymakers, the public, and media) and who want to improve diabetes-related health equity.[15]

CONCLUSIONS

Between 2008–2021, age, sex, racial and ethnic, and education inequalities in diagnosed diabetes incidence declined while income-related inequalities in diabetes prevalence increased over time. Overall, diagnosed diabetes inequalities persisted with disadvantaged groups having higher prevalence and incidence. Monitoring changes in inequality trends could provide a benchmark for assessing future progress in addressing these inequalities and help inform programs and policies to improve these inequalities. To close these gaps, future research could focus on identifying factors driving these inequalities including morbidity and mortality as contributing factors.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Appendix

Methods.

Between Group Variance and Slope Index of Inequality Calculations

Between Group Variance[1]

The BGV was calculated using the following formula: $BGV = \sum_{j=1}^{J} p_j (y_j - \mu)^2$

Where j represents the social group (e.g., sex and race), p_j is group j's proportion of the total population, y_j is group j's diabetes prevalence or incidence, and μ is the average diabetes prevalence or incidence of the population.

Slope Index of Inequality[1]

The SII is obtained from the linear regression model: $\mu_j = \beta_0 + \beta_1 R_j \ for \ j = 1 - J$ where μ_j is the average prevalence or incidence of social group j, R_j is the average relative ranking of social group j ranked based on the midpoint of their range in the cumulative distribution in the population, β_0 is the health status of the hypothetical person at the bottom of the social group hierarchy (i.e., when $R_j = 0$), and β_1 (i.e., the SII) is the difference in average health status between the hypothetical person at the bottom of the social group distribution and the hypothetical person at the top ($R_j = 0 \ vs. \ R_j = 1$) assuming linearity. Since grouped data is used for the regression model, it is often estimated through weighted least squares, with weights equal to the population share of group j using the following formula: $SII = \frac{\sum_{j=1}^{J} p_j R_j (\mu_j - \mu)}{\sum_{j=1}^{J} p_j R_j^2 - \left(\sum_{j=1}^{J} p_j R_j\right)^2}$, where μ_j is the average prevalence or incidence of group j, p_j is group j's proportion of the total population, R_j is group j's relative social group ranking calculated as $R_j = \sum_{\gamma}^{j-1} p_\gamma - 0.5 p_j$, and μ is the average diabetes prevalence or incidence in the population estimated as $\mu = \sum_{j=1}^{J} p_j \mu_j$.

Appendix Table 1.

Sociodemographic characteristics of US adults ≥18 years of age from 2008–2021

Characteristics, % (SE)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Age														
18–44	49.1 (0.53)	48.5 (0.53)	48.2 (0.46)	47.9 (0.42)	47.3 (0.43)	47.1 (0.44)	46.8 (0.47)	46.5 (0.46)	46.3 (0.46)	46.1 (0.49)	46.1 (0.48)	45.9 (0.44)	45.7 (0.45)	45.6 (0.43
45–64	34.3 (0.44)	34.8 (0.43)	34.9 (0.39)	34.9 (0.36)	34.9 (0.36)	34.7 (0.38)	34.5 (0.39)	34.3 (0.38)	34.1 (0.37)	33.9 (0.41)	33.3 (0.38)	32.9 (0.34)	32.5 (0.36)	32.1 (0.35

Characteristics, % (SE)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
≥65	16.6 (0.34)	16.6 (0.34)	16.9 (0.33)	17.2 (0.29)	17.8 (0.30)	18.3 (0.29)	18.8 (0.34)	19.2 (0.35)	19.6 (0.32)	20.1 (0.33)	20.6 (0.36)	21.2 (0.30)	21.8 (0.33)	22.4 (0.31)
Sex														
Female	51.7 (0.44)	51.7 (0.37)	51.7 (0.39)	51.6 (0.35)	51.9 (0.37)	51.8 (0.37)	51.8 (0.39)	51.8 (0.37)	51.8 (0.37)	51.8 (0.39)	51.7 (0.39)	51.7 (0.36)	51.7 (0.37)	51.7 (0.34)
Male	48.3 (0.44)	48.3 (0.37)	48.3 (0.39)	48.5 (0.35)	48.1 (0.37)	48.2 (0.37)	48.2 (0.39)	48.2 (0.37)	48.2 (0.37)	48.2 (0.39)	48.3 (0.39)	48.3 (0.36)	48.3 (0.37)	48.3 (0.34)
Race and ethnicity														
Hispanic	13.8 (0.46)	14.0 (0.45)	14.2 (0.43)	14.5 (0.42)	15.2 (0.45)	15.3 (0.46)	15.6 (0.46)	15.9 (0.47)	16.2 (0.75)	16.4 (0.77)	16.8 (0.74)	17.0 (0.69)	17.2 (0.73)	17.4 (0.70)
NH Asian	4.6 (0.18)	4.6 (0.21)	4.7 (0.18)	4.8 (0.17)	5.3 (0.18)	5.5 (0.19)	5.6 (0.20)	5.8 (0.19)	5.9 (0.31)	6.0 (0.35)	6.3 (0.35)	6.0 (0.28)	6.1 (0.32)	6.1 (0.28)
NH Black	11.8 (0.46)	11.8 (0.42)	11.8 (0.43)	11.7 (0.37)	11.7 (0.36)	11.8 (0.37)	11.9 (0.37)	12.0 (0.38)	12.0 (0.48)	12.1 (0.56)	12.0 (0.51)	12.1 (0.47)	12.0 (0.51)	12.0 (0.48)
NH White	69.8 (0.68)	69.6 (0.67)	69.2 (0.67)	69.0 (0.62)	67.8 (0.62)	67.4 (0.60)	67.0 (0.63)	66.3 (0.62)	65.9 (0.89)	65.5 (0.93)	64.9 (0.89)	64.9 (0.82)	64.7 (0.87)	64.5 (0.84)
Education														
<High School	15.5 (0.38)	14.8 (0.34)	14.4 (0.34)	14.3 (0.32)	14.0 (0.30)	13.8 (0.30)	13.4 (0.31)	12.6 (0.30)	12.3 (0.34)	11.9 (0.36)	11.4 (0.38)	12.4 (0.37)	11.9 (0.39)	9.5 (0.31)
High School	27.7 (0.46)	27.8 (0.42)	26.9 (0.39)	26.7 (0.39)	26.3 (0.37)	26.1 (0.39)	26.0 (0.39)	24.8 (0.39)	25.0 (0.42)	24.2 (0.42)	24.5 (0.43)	27.5 (0.37)	28.4 (0.41)	28.4 (0.44)
Some College	30.1 (0.42)	30.5 (0.38)	30.5 (0.37)	31.2 (0.34)	31.3 (0.39)	30.9 (0.35)	30.7 (0.38)	31.1 (0.40)	31.1 (0.41)	30.3 (0.49)	30.6 (0.39)	31.1 (0.39)	30.4 (0.39)	26.6 (0.35)
≥Bachelors	26.7 (0.52)	26.9 (0.49)	28.2 (0.51)	27.8 (0.48)	28.4 (0.47)	29.2 (0.47)	29.9 (0.46)	31.5 (0.54)	31.7 (0.58)	33.6 (0.65)	33.5 (0.56)	29.0 (0.48)	29.4 (0.47)	35.6 (0.53)
Family poverty-to-income ratio														
<1.0	11.7 (0.37)	12.5 (0.32)	13.4 (0.34)	13.9 (0.31)	14.0 (0.33)	13.6 (0.33)	13.9 (0.33)	12.6 (0.32)	12.7 (0.34)	12.0 (0.37)	11.2 (0.33)	11.2 (0.32)	9.9 (0.31)	9.8 (0.31)
1.0–2.9	34.7 (0.53)	35.6 (0.48)	36.0 (0.47)	35.4 (0.46)	35.7 (0.43)	36.0 (0.43)	35.2 (0.44)	35.1 (0.46)	33.5 (0.46)	32.5 (0.50)	33.3 (0.49)	35.6 (0.47)	35.2 (0.49)	33.9 (0.47)
3.0–4.9	24.7 (0.41)	24.7 (0.42)	23.8 (0.36)	24.0 (0.32)	23.3 (0.34)	23.8 (0.35)	23.3 (0.39)	22.7 (0.38)	23.9 (0.40)	24.4 (0.38)	23.9 (0.38)	24.5 (0.35)	25.0 (0.39)	24.8 (0.36)
≥5.0	29.0 (0.57)	27.3 (0.55)	26.9 (0.57)	26.7 (0.53)	26.9 (0.49)	26.6 (0.50)	27.5 (0.54)	29.6 (0.58)	29.9 (0.60)	31.1 (0.64)	31.6 (0.57)	28.8 (0.49)	30.0 (0.54)	31.4 (0.50)

Abbreviations: SE = standard error, NH = non-Hispanic.

Note: Sociodemographic characteristics were compared across years with chi-squared tests. All p-values <0.001 except for sex (p-value=0.96).

Appendix Table 2.

Trends in diagnosed diabetes prevalence and incidence by age, education, poverty-to-income ratio, race, ethnicity, and sex among US adults from 2008–2021

Demographic Characteristics	Prevalence, AAPC, % (95% CI)	Incidence, AAPC, % (95% CI)
Overall	0.06 (−0.38, 0.51)	−3.33 (−4.32, −2.33)
Age, years		
18–44	−0.16 (−1.83, 1.54)	−1.19 (−3.54, 1.22)

Demographic Characteristics	Prevalence, AAPC, % (95% CI)	Incidence, AAPC, % (95% CI)
45–64	0.19 (−0.38, 0.77)	−3.28 (−4.70, −1.83)
≥65	0.01 (−0.70, 0.72)	−5.12 (−7.29, −2.89)
Education		
<high school	0.60 (0.21, 0.99)	−4.31 (−6.47, −2.11)
high school diploma/GED	0.21 (−0.60, 1.03)	−2.93 (−5.11, −0.70)
some college/associates degree	0.76 (0.08, 1.45)	−3.11 (−5.46, −0.71)
bachelor's degree and higher	−0.13 (−1.05, 0.79)	−2.08 (−3.63, −0.50)
Poverty-to-income ratio		
<1.0	1.13 (0.16, 2.12)	−3.88 (−5.98, −1.74)
1.0–2.9	0.57 (−0.004, 1.14)	−1.72 (−4.00, 0.61)
3.0–4.9	−0.22 (−0.81, 0.38)	−5.08 (−6.97, −3.16)
≥5.0	−0.62 (−1.50, 0.27)	−3.04 (−5.32, −0.70)
Race and Ethnicity		
Hispanic	−0.24 (−0.87, 0.40)	−4.78 (−7.14, −2.36)
Non-Hispanic Asian	0.96 (0.04, 1.89)	−2.08 (−7.03, 3.12)
Non-Hispanic Black	−0.17 (−0.94, 0.60)	−3.66 (−6.67, −0.56)
Non-Hispanic White	−0.35 (−0.91, 0.21)	−3.54 (−5.25, −1.79)
Sex		
Female	−0.02 (−0.53, 0.50)	−4.02 (−5.34, −2.67)
Male	0.18 (−0.49, 0.86)	−2.67 (−4.51, −0.79)

Abbreviations: CI = confidence interval, AAPC = Average Annual Percent Change

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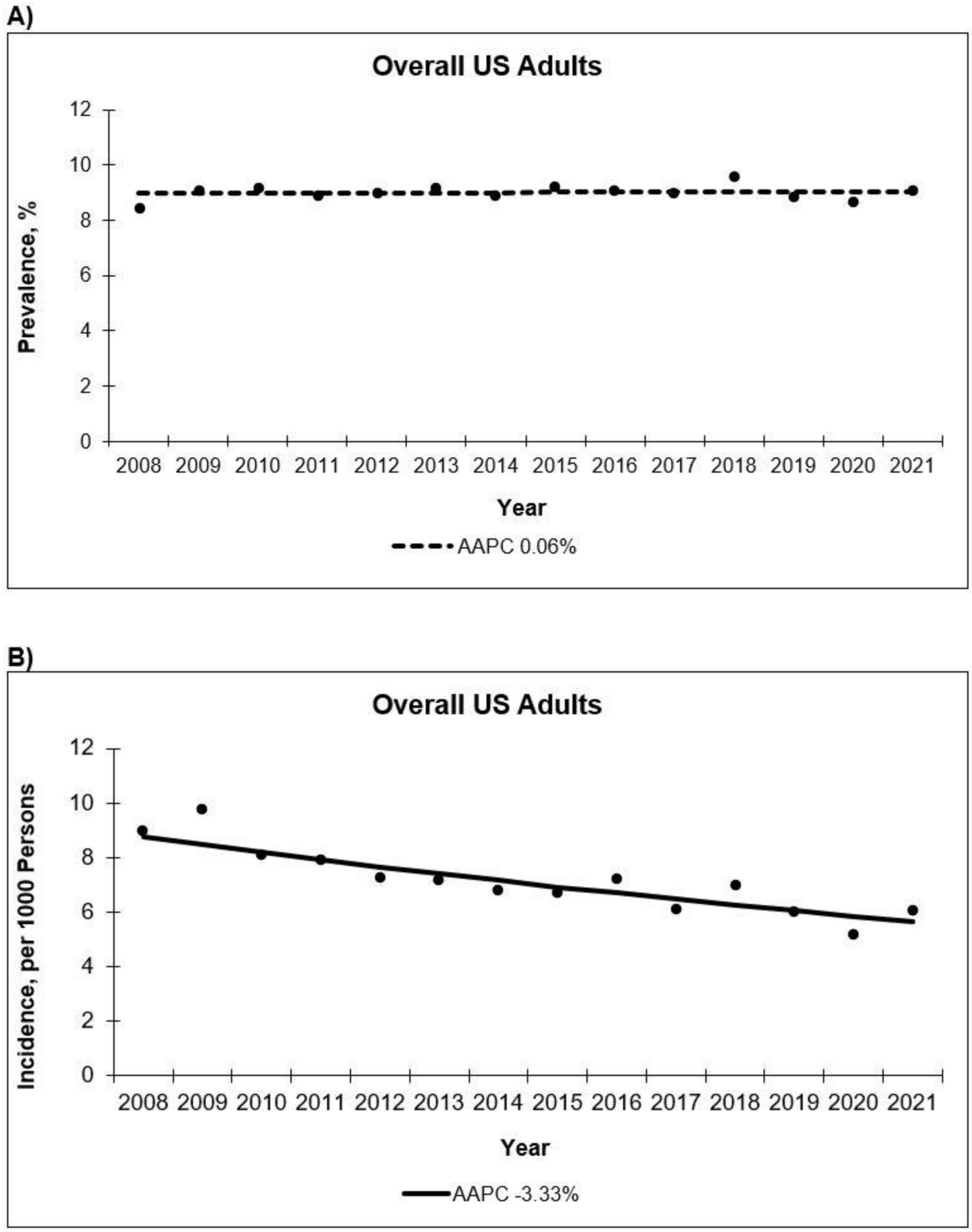

Figure 1.

Trends in age-adjusted A) prevalence and B) incidence of diagnosed diabetes among overall US adults from 2008–2021. Abbreviations: AAPC = Average annual percentage change, CI = Confidence interval. Dots are observed values. The dotted lines indicate no significant trend; solid lines indicate a significant average annual percentage change.

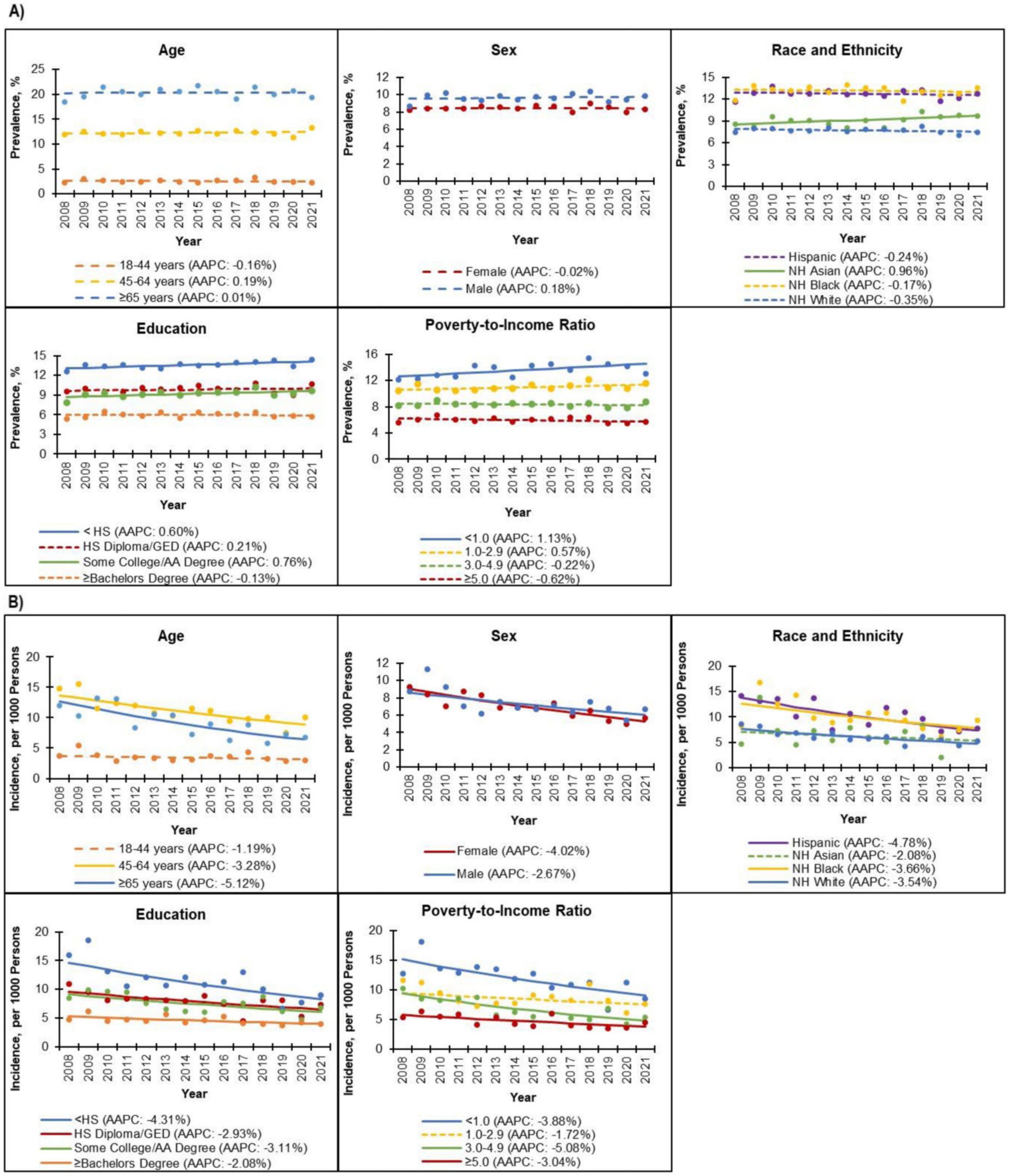

Figure 2.

Trends in age-adjusted A) prevalence and B) incidence of diagnosed diabetes among US adults from 2008–2021. Abbreviations: AAPC = Average annual percentage change, NH = non-Hispanic, HS = High School, AA = Associates. Dots are observed values. The dotted lines indicate no significant trend; solid lines indicate a significant average annual percentage change.

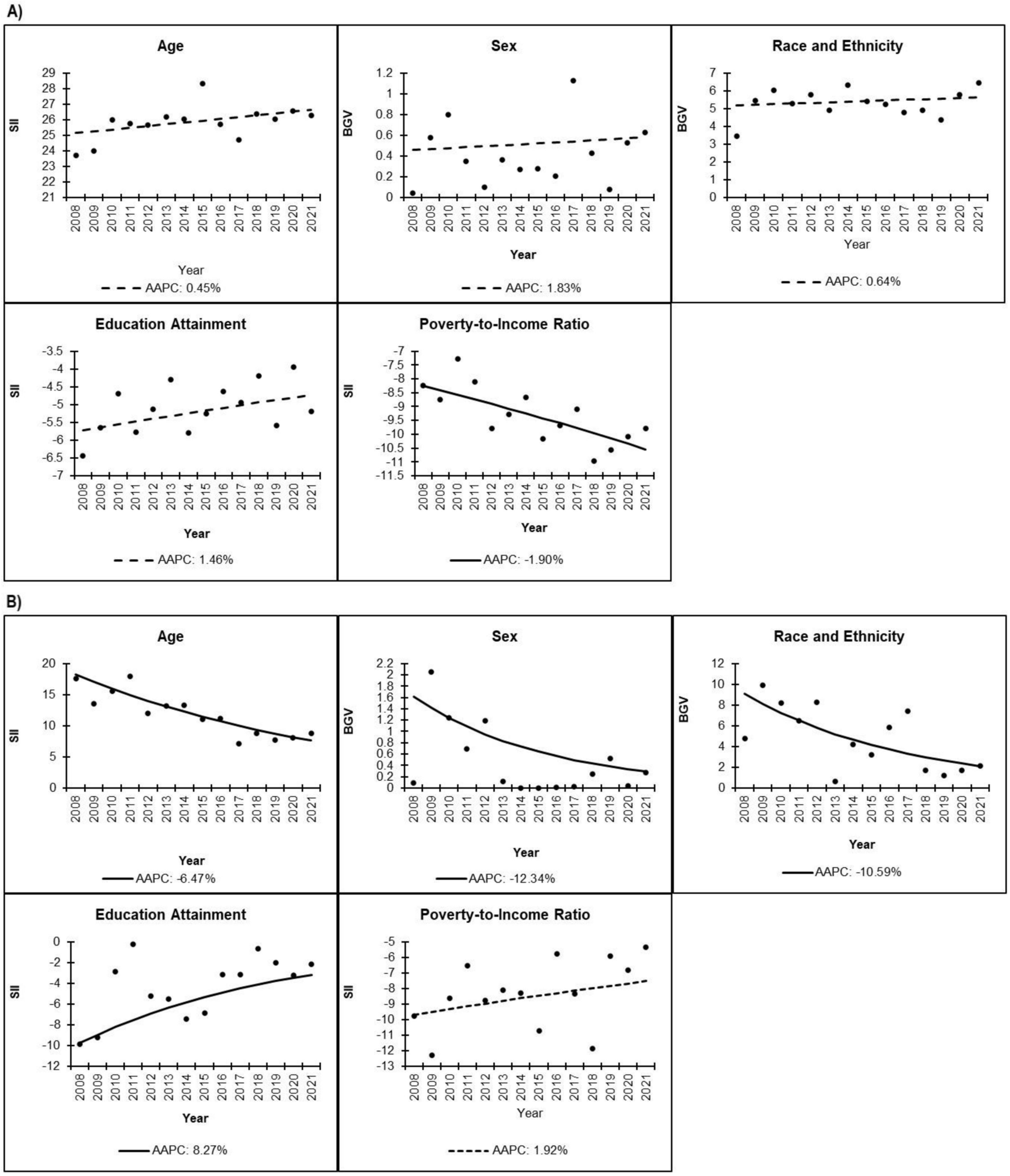

Figure 3.

Trends in absolute inequalities in age-adjusted diagnosed diabetes A) prevalence and B) incidence among US adults from 2008–2021. Abbreviations: BGV = between group variance, SII = slope index of inequality, AAPC = Average annual percentage change. Dots are observed values. The dotted lines indicate no significant trend; solid lines indicate a significant average annual percentage change. A value of 0 represents no inequality while a value further from 0 represents greater inequality for both the BGV and SII. The positive SII value for age group indicates greater diabetes prevalence and incidence among the older age groups while the negative SII values for both the education and family poverty-to-income (PIR) diabetes prevalence and incidence, suggests a higher concentration of diabetes prevalence and incidence among the lower education and PIR groups.

Table 1.

Measures of absolute inequalities in age-adjusted diabetes prevalence and incidence estimates for US adults, 2008–2021

Demographic Characteristics	Inequality Index[a] (95% CI), 2008–2021[b]	AAPC, % (95% CI)
Age, SII		
Prevalence	25.85 (25.40, 26.30)	0.45 (−0.13, 1.02)
Incidence	11.55 (10.49, 12.61)	**−6.47 (−8.37, −4.53)****
Education, SII		
Prevalence	−8.17 (−8.55, −7.78)	1.46 (−0.29, 3.18)
Incidence	−7.33 (−8.48, −6.18)	**8.27 (3.29, 13.00)****
Poverty-to-Income, SII		
Prevalence	−9.35 (−9.77, −8.93)	**−1.90 (−3.05, −0.76)****
Incidence	−8.37 (−9.70, −7.05)	1.92 (−2.02, 5.70)
Race and Ethnicity, BGV		
Prevalence	5.18 (4.58, 5.79)	0.64 (−1.53, 2.86)
Incidence	3.09 (1.78, 4.40)	**−10.59 (−17.44, −3.16)***
Sex, BGV		
Prevalence	0.36 (0.22, 0.51)	1.83 (−7.20, 11.75)
Incidence	0.04 (−0.11, 0.18)	**−12.34 (−18.55, −5.66)****

Note: Boldface indicates statistical significance

*(p<0.05,

**p<0.01)

Abbreviations: CI = confidence interval, AAPC = Average Annual Percent Change, SII = slope index of inequality, BGV = between-group variance

[a]A value of 0 represents no inequality while a value further from 0 represents greater inequality for both the BGV and SII. The positive SII value for age group indicates greater diabetes prevalence and incidence among the older age groups while the negative SII values for both the education and family poverty-to-income (PIR) diabetes prevalence and incidence, suggests a higher concentration of diabetes prevalence and incidence among the lower education and PIR groups.

[b]Pooled across all years of the study period