Disparities in the Prevalence of Diagnosed Diabetes — United States, 1999–2002 and 2011–2014

Gloria L. Beckles, MD[1], Chiu-Fang Chou, DrPH[1]

The prevalence of diabetes mellitus has increased rapidly in the United States since the mid-1990s. By 2014, an estimated 29.1 million persons, or 9.3% of the total population, had received a diagnosis of diabetes (1). Recent evidence indicates that the prevalence of diagnosed diabetes among non-Hispanic black (black), Hispanic, and poorly educated adults continues to increase but has leveled off among non-Hispanic whites (whites) and persons with higher education (2). During 2004–2010, CDC reported marked racial/ethnic and socioeconomic position disparities in diabetes prevalence and increases in the magnitude of these disparities over time (3). However, the magnitude and extent of temporal change in socioeconomic position disparities in diagnosed diabetes among racial/ethnic populations are unknown. CDC used data from the National Health Interview Survey (NHIS) for the periods 1999–2002 and 2011–2014 to assess the magnitude of and change in socioeconomic position disparities in the age-standardized prevalence of diagnosed diabetes in the overall population and among blacks, whites, and Hispanics. During each period, significant socioeconomic position disparities existed in the overall population and among the assessed racial/ethnic populations. Disparities in prevalence increased with increasing socioeconomic disadvantage and widened over time among Hispanics and whites but not among blacks. The persistent widening of the socioeconomic position gap in prevalence suggests that interventions to reduce the risk for diabetes might have a different impact according to socioeconomic position.

To assess progress toward eliminating socioeconomic position disparities in diabetes prevalence, CDC used NHIS data for the periods 1999–2002 and 2011–2014 (4). These survey periods were selected to allow for prevalence estimates that were relatively similar within each period and distinct between the comparison periods (5). NHIS is an ongoing, cross-sectional, household interview survey of a representative sample of the civilian, noninstitutionalized, U.S. population. A randomly selected adult (aged ≥18 years) in each family was asked whether they had ever been told by a health care professional that they had diabetes; women who were told only during pregnancy were considered not to have diabetes. Prevalence was calculated for adults aged ≥18 years. Statistical software was used to account for the complex sampling design. Data were weighted to provide representative population estimates.

Estimates were age-standardized by the direct method to the 2000 U.S. Census population.

Socioeconomic position disparities for the periods 1999–2002 and 2011–2014 and the change in the magnitude of these disparities between the two periods were measured in the overall population and within the three largest U.S. racial/ethnic populations (white, black, and Hispanic). Socioeconomic position was defined by educational attainment (less than high school, high school diploma/General Education Diploma, some college, and college degree or higher) and the income-to-poverty ratio (IPR) (poor <100% federal poverty level [FPL]; near poor 100%–199% FPL; middle-income 200%–399% FPL; and high-income ≥400% FPL) (6). The category of each socioeconomic position indicator with the lowest prevalence was designated as the referent category. The magnitudes of the disparities in each period were calculated by pairwise comparison to estimate the absolute difference (i.e., percentage-point difference) between the values in each educational attainment or IPR subgroup and the respective referent group (3,7). The relative difference (i.e., percentage difference) was calculated by dividing the absolute difference by the referent value.

Marked changes in the distributions of the socioeconomic position indicators occurred in the U.S. population between the periods studied. For example, in the 2011–2014 NHIS sample, the proportion of persons reporting less than a high school education declined by 3.6 percentage points (ppt) overall, with the greatest declines occurring among Hispanics (-9.3 ppt) and blacks (-7.4 ppt). To account for these changes when assessing the population impact of the health disparities, weighted least squares regression was used to estimate summary measures of percentage and percentage-point differences in socioeconomic position (7). The magnitude and direction of changes over time were assessed as the simple differences between the periods, expressed as a percentage. Using the z-score and a two-tailed t-test, differences were considered significant at p<0.05.

Overall and within each racial/ethnic population, significant socioeconomic position disparities in the age-standardized prevalence of self-reported physician-diagnosed diabetes that increased in magnitude with decreasing socioeconomic advantage were identified (Table 1). During 1999–2002, the absolute disparities between the least and most educated groups and between the lowest and highest IPR groups were 4.2 ppt and 3.7 ppt, respectively.

TABLE 1. Socioeconomic position disparities in age-standardized prevalence of physician-diagnosed diabetes among adults aged ≥18 years, overall and by three racial/ethnic populations — National Health Interview Survey, United States, 1999–2002 and 2011–2014

Socioeconomic position indicator	1999–2002				2011–2014			
	No. in sample	Age-standardized % (95% CI)	Absolute (percentage-point) difference	Relative (%) difference	No. in sample	Age-standardized % (95% CI)	Absolute (percentage-point) difference	Relative (%) difference
Educational attainment								
All racial/ethnic populations combined								
<High school	25,776	7.8 (7.5–8.2)	4.2*	116.0*	21,740	11.0 (10.6–11.5)	6.0*	120.4*
High school/GED	36,599	5.7 (5.5–6.0)	2.1*	57.0*	35,781	8.3 (8.0–8.6)	3.3*	65.6*
Some college	35,509	5.0 (4.7–5.3)	1.4*	37.5*	42,286	7.5 (7.2–7.8)	2.5*	49.4*
College or higher	28,199	3.6 (3.4–3.9)	ref	ref	38,241	5.0 (4.8–5.3)	ref	ref
White, non-Hispanic								
<High school	11,162	7.2 (6.7–7.8)	4.0*	123.5*	8,059	10.0 (9.2–10.8)	5.6*	126.3*
High school/GED	25,580	5.2 (4.0–5.5)	1.9*	59.8*	21,791	7.6 (7.2–8.1)	3.2*	73.0*
Some college	24,726	4.5 (4.3–4.8)	1.3*	40.2*	27,284	6.7 (6.3–7.0)	2.3*	51.2*
College or higher	21,942	3.2 (3.0–3.5)	ref	ref	27,004	4.4 (4.1–4.7)	ref	ref
Black, non-Hispanic								
<High school	4,353	9.9 (9.0–10.8)	2.7*	37.3*	3,840	13.3 (12.2–14.4)	4.7*	55.6*
High school/GED	5,178	9.5 8.6–10.5)	2.3*	32.3*	6,058	11.3 (10.4–12.2)	2.8*	32.3*
Some college	5,212	7.8 (6.8–8.9)	0.6	8.2	6,680	11.8 (10.9–12.8)	3.3*	38.4*
College or higher	2,556	7.2 (6.0–8.6)	ref	ref	3,787	8.5 (7.5–9.6)	ref	ref
Hispanic								
<High school	9,653	8.9 (8.2–9.6)	2.8*	47.0*	8,705	12.6 (11.8–13.3)	5.7*	83.4*
High school/GED	4,955	7.0 (6.0–8.0)	0.9	15.1	6,040	10.5 (9.5–11.5)	3.6*	52.6*
Some college	4,396	7.4 (6.1–8.9)	1.3	22.0	5,854	9.6 (8.5–10.8)	2.7*	39.6*
College or higher	1,909	6.0 (4.3–8.4)	ref	ref	2,901	6.9 (5.8–8.1)	ref	ref
Income-to-poverty ratio†								
All racial/ethnic populations combined								
Poor	19,453	7.9 (7.4–8.3)	3.7*	88.1*	25,056	10.9 (10.5–11.4)	5.5*	100.4*
Near poor	25,596	7.0 (6.7–7.4)	2.8*	66.7*	29,389	9. 5 (9.1–9.9)	4.0*	74.1*
Middle income	39,745	5.6 (5.3–5.8)	1.4*	33.3*	40,462	7.6 (7.4–7.9)	2.2*	40.0*
High income	42,629	4.2 (3.9–4.4)	ref	ref	43,791	5.5 (5.2–5.7)	ref	ref
White, non-Hispanic								
Poor	8,271	6.8 (6.2–7.5)	3.0*	78.7*	10,292	9.7 (9.5–10.4)	4.9*	101.7*
Near poor	14,383	6.2 (5.8–6.7)	2.4*	62.5*	15,184	8.7 (9.1–9.2)	3.8*	79.5*
Middle income	27,639	5.1 (4.9–5.4)	1.3*	34.9*	26,133	7.0 (6.6–7.3)	2.1*	44.4*
High income	33,849	3.8 (3.6–4.1)	ref	ref	32,768	4.8 (4.6–5.1)	ref	ref
Black, non-Hispanic								
Poor	4,501	9.7 (8.7–10.7)	2.4*	31.9*	5,929	12.8 (11.8–13.8)	3.4*	36.9*
Near poor	4,235	10.2 (9.2–11.3)	2.9*	39.2*	5,203	12.0 (11.1–13.0)	2.7*	29.2*
Middle income	5,053	8.3 (7.4–9.2)	1.0	12.8	5,468	11.1 (10.2–12.1)	1.8*	19.5*
High income	3,730	7.3 (6.1–8.8)	ref	ref	3,897	9.3 (8.2–10.5)	ref	ref
Hispanic								
Poor	5,899	9.3 (8.3–10.3)	2.5*	36.4*	6,190	12.8 (11.9–13.8)	3.8*	42.3*
Near poor	6,160	8.8 (7.9–9.8)	2.0*	29.6*	7,084	11.0 (10.2–11.9)	2.0*	22.2*
Middle income	5,832	6.8 (5.9–7.8)	-0.02	-0.3	6,215	9.7 (8.9–10.7)	0.7	8.2
High income	3,346	6.8 (5.4–8.5)	ref	ref	3,499	9.0 (7.8–10.3)	ref	ref

Abbreviations: CI = confidence interval; GED = General Education Diploma; ref = referent.
* Difference between the group estimate and the reference category significant at p<0.05.
† Based on the federal poverty level (FPL): poor, <100% FPL; near poor, 100–199% FPL; middle income, 200–399% FPL; high income, ≥400% FPL.

During 2011–2014, these absolute disparities had widened to 6.0 ppt and 5.5 ppt. Similar patterns in socioeconomic position disparities in the age-standardized prevalence of diagnosed diabetes were observed for each racial/ethnic population (Table 1).

The regression-based summary measure of absolute differences indicated that the socioeconomic position disparities in prevalence were not limited to the extremes of the distributions of each socioeconomic position indicator, but were present across all socioeconomic subgroups in the entire population

(Table 2). During 1999–2002, both the average difference in prevalence from the lowest to the highest education group and the average difference across the IPR groups were -4.7 ppt. During 2011–2014, the magnitude of the absolute prevalence differences for educational attainment (-6.7 ppt) and IPR (-7.1 ppt) were significantly larger than during 1999–2002, indicating that socioeconomic position disparities in the prevalence of age-standardized diagnosed diabetes widened over time in the overall population.

TABLE 2. Regression-based summary measures of absolute* and relative† educational attainment and income-to-poverty ratio disparities in age-standardized prevalence of physician diagnosed diabetes and change in disparities over time among adults aged ≥18 years, overall and by three racial/ethnic populations — National Health Interview Survey, United States, 1999–2002 and 2011–2014

Socioeconomic position indicator	Absolute (percentage-point) difference (95% CI)			Relative (%) difference (95% CI)		
	1999–2002	2011–2014	% change, 1999–2002 to 2011–2014	1999–2002	2011–2014	% change, 1999–2002 to 2011–2014
Educational attainment						
All racial/ethnic populations combined	-4.7 (-5.4 to -4.2)	-6.7 (-7.2 to -6.1)	-41.5§	-0.9 (-1.0 to -0.8)	-0.9 (-1.0 to -0.8)	-2.0
White, non-Hispanic	-4.1 (-5.4 to -3.7)	-6.0 (-6.7 to -5.3)	-44.2§	-0.9 (-1.0 to -0.8)	-0.9 (-1.0 to -0.8)	-5.3
Black, non-Hispanic	-3.7 (-5.4 to -2.0)	-4.3 (-6.0 to -2.6)	-16.4	-0.4 (-0.6 to -0.2)	-0.4 (-0.5 to -0.2)	9.5
Hispanic	-3.4 (-5.4 to -1.4)	-6.4 (-8.1 to -4.7)	-89.1¶	-0.4 (-0.7 to -0.2)	-0.6 (-0.8 to -0.4)	-40.5
Income-to-poverty ratio**						
All racial/ethnic populations combined	-4.7 (-5.3 to -4.2)	-7.1 (-7.6 to -6.5)	-49.4§	-0.9 (-1.0 to -0.8)	-0.9 (-1.0 to -0.9)	-8.7
White, non-Hispanic	-3.8 (-4.5 to -3.2)	-6.4 (-7.1 to -5.7)	-66.9§	-0.8 (-0.9 to -0.7)	-1.0 (-1.1 to -0.9)	-23.6¶
Black, non-Hispanic	-3.6 (-5.6 to -1.6)	-4.4 (-6.2 to -2.6)	-22.1	-0.4 (-0.6 to -0.2)	-0.4 (-0.6 to -0.2)	5.4
Hispanic	-3.8 (-5.8 to -1.7)	-4.9 (-6.6 to -3.1)	-28.5	-0.5 (-0.7 to -0.2)	-0.5 (-0.6 to -0.3)	5.1

Abbreviation: CI = confidence interval.

  * The socioeconomic position domain consists of groups ordered from the lowest to the highest levels of educational attainment and income-to-poverty ratio (IPR). The summary measure of absolute difference was obtained by using regression to fit a straight line to the prevalence estimates ordered from the lowest to the highest levels of educational attainment or IPR. The slope of the regression line is interpreted as the average absolute change in the age-standardized prevalence of diagnosed diabetes from the lowest to the highest level of each socioeconomic position indicator. The regression-based summary measure of absolute difference, also known as the Slope Index of Inequality, is expressed in percentage points. **Source:** Keppel K, Pamuk E, Lynch J, et al. Methodological issues in measuring health disparities. Vital Health Stat 2 2005;141:1–16.

  † The summary measure of relative difference was obtained by dividing the absolute difference by the prevalence of age-standardized diagnosed diabetes in the total population. It is interpreted as the average percentage change in the age-standardized prevalence of diagnosed diabetes from the lowest to the highest level of each socioeconomic position indicator. The regression-based summary relative difference, also known as the Relative Index of Inequality, is expressed as a percentage.

  § Difference between the absolute differences during 1999–2002 and 2011–2014 significant at p<0.01.

  ¶ Difference significant at p<0.05.

 ** Based on the federal poverty level.

During 1999–2002, the summary measure of educational disparities in diabetes prevalence showed no significant racial/ethnic differences (whites [-4.1 ppt], blacks [-3.7 ppt], and Hispanics [-3.4 ppt]) (Table 2). By 2011–2014, the summary measure of absolute differences for education and IPR disparities in prevalence had widened between whites (-6.0 ppt [education] and -6.4 ppt [IPR]) and Hispanics (-6.4 ppt [education] and -4.9 ppt [IPR]). Among blacks, the magnitudes of absolute differences (-4.3 ppt and -4.4 ppt) were similar to those in the earlier period (-3.7 ppt and -3.6 ppt). The patterns of relative socioeconomic position disparities in the age-standardized prevalence were similar in each racial/ethnic group.

Changes in socioeconomic position disparities in the age-standardized prevalence of diagnosed diabetes over time were observed (Table 2). The regression-based summary measure of absolute socioeconomic position disparity was significantly higher during 2011–2014 than during 1999–2002, indicating that the gap in prevalence between the referent and lower socioeconomic position groups widened. The average absolute educational and IPR disparities in diabetes prevalence increased by at least 40% in the overall population (41.5% [education], 49.4% [IPR]) and among whites (44.2% [education], 66.9% [IPR]), but showed no significant change over time among blacks (16.4% [education], 22.1% [IPR]) (Table 2). Although

the average absolute educational disparities in diabetes prevalence among Hispanics increased over time, there were no statistical differences in the IPR-related prevalence disparities. As expected, the changes in the regression-based summary measure of relative differences were smaller; only the increasing relative IPR disparity among whites was statistically significant, but most were in the same direction as the absolute differences.

Discussion

During 1999–2002 and 2011–2014, significant socioeconomic position disparities in the age-standardized prevalence of self-reported physician-diagnosed diabetes existed among U.S. adults in the overall population and among blacks, whites, and Hispanics. During each period, socioeconomic position disparities were present from the lowest to the highest socioeconomic position group and increased with socioeconomic disadvantage. Socioeconomic position disparities in prevalence among whites widened over time, whereas no significant temporal change was observed among blacks. Among Hispanics, educational disparities in prevalence widened over time, but IPR disparities did not.

The findings in this report are consistent with an earlier report describing the presence of and temporal increase in socioeconomic position disparities in diabetes prevalence in

the overall U.S. population (*3*). However, these findings are not strictly comparable with that report. First, this study examined a longer interval than the 5-year intervals studied earlier; the disparities observed over the longer interval might reflect more closely the population response to diabetes risk-reduction efforts. In addition, the summary measures indicated that the socioeconomic position disparities were present across the entire distribution of each socioeconomic position indicator rather than just at the extremes, and differed by racial/ethnic population. The racial/ethnic analyses revealed that the socioeconomic position disparities in prevalence increased over time, even among whites, the group with the lowest diabetes prevalence.

The findings in this report are subject to at least two limitations. First, all data are self-reported and therefore subject to recall and social desirability bias. However, self-reported diagnosed diabetes has been shown to have high reliability (*2*). To avoid bias related to the high nonresponse to survey questions on income, NHIS datasets with imputed income were used. Second, these findings do not reflect disparities in the prevalence of all diabetes (diagnosed plus undiagnosed); approximately 28% of all diabetes is undiagnosed (*2*) and might vary by socioeconomic position and race/ethnicity. However, the socioeconomic patterning of disparities in prevalence of diagnosed diabetes is consistent with reports on diabetes risk in the U.S. adult population (*2*).

One of the overarching goals of *Healthy People 2020* is to achieve health equity, eliminate disparities, and improve the health of all groups.* Evidence-based public health interventions that are designed to delay or prevent diabetes target diabetes-related lifestyle factors such as obesity, physical inactivity, and poor dietary habits, which increase with decreasing socioeconomic circumstances among persons and the places where they live (*8*). The persistent widening of the socioeconomic position gap in the prevalence of physician-diagnosed diabetes observed in this study is consistent with an increasing body of evidence that suggests that interventions to reduce diabetes or its risk factors can have different impacts according to socioeconomic position (*9,10*). Evaluation of the effectiveness of such interventions across socioeconomic groups might be critical to understanding whether risk reduction efforts achieve the national health equity goal.

---

* https://www.healthypeople.gov/sites/default/files/HP2020_brochure_with_LHI_508_FNL.pdf.

Summary

What is already known about this topic?

During the first decade of the 2000s, marked socioeconomic position disparities in the age-standardized prevalence of physician-diagnosed diabetes were found among the U.S. adult population. These disparities widened over time.

What is added by this report?

This report confirmed the presence of substantial socioeconomic position disparities in the overall population. In 1992–2002, the absolute differences in education and income-to-poverty ratio (IPR) were both 4.7 percentage points (ppt). In 2011–2014, the differences were 6.1 ppt for education and 7.1 for IPR. Similar patterns were observed among non-Hispanic blacks, non-Hispanic whites, and Hispanics. The report also provides evidence that socioeconomic position disparities widened over time.

What are the implications for public health practice?

Eliminating disparities and achieving health equity are important U.S. public health goals. Interventions designed to achieve health equity target lifestyle factors such as obesity, physical inactivity and poor dietary habits that are most common among persons and in places associated with low socioeconomic circumstances. The widening socioeconomic position disparities in diagnosed diabetes in the interval between 1999–2002 and 2011–2014 suggests that efforts at diabetes risk reduction might have had differential impact by socioeconomic position. Evaluation of the effectiveness of interventions across socioeconomic groups might be crucial to understanding the extent to which national goals are achieved.

[1]Division of Diabetes Translation, National Center for Chronic Disease Prevention and Health Promotion, CDC.

Corresponding author: Gloria L. Beckles, glb4@cdc.gov, 770-488-1272.

References

1. CDC. National Diabetes Surveillance System. National diabetes statistics report, 2014. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. http://www.cdc.gov/diabetes/pubs/statsreport14/national-diabetes-report-web.pdf
2. Geiss LS, Wang J, Cheng YJ, et al. Prevalence and incidence trends for diagnosed diabetes among adults aged 20 to 79 years, United States, 1980–2012. JAMA 2014;312:1218–26. http://dx.doi.org/10.1001/jama.2014.11494
3. Beckles GL, Chou CF. Diabetes—United States, 2006 and 2010. MMWR Suppl 2013;62(03):99–104.
4. National Center for Health Statistics. 2014 National Health Interview Survey (NHIS). Survey Description. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2015. http://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2014/srvydesc.pdf

5. National Center for Health Statistics. Health, United States, 2015: with special feature on racial and ethnic health disparities. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2016. http://www.cdc.gov/nchs/data/husis.pdf#o40

6. Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: concepts, methodologies, and guidelines. Annu Rev Public Health 1997;18:341–78. http://dx.doi.org/10.1146/annurev.publhealth.18.1.341

7. Keppel K, Pamuk E, Lynch J, et al. Methodological issues in measuring health disparities. Vital Health Stat 2 2005;141:1–16.

8. CDC. National Diabetes Prevention Program. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. http://www.cdc.gov/diabetes/prevention/index.html

9. Beauchamp A, Backholer K, Magliano D, Peeters A. The effect of obesity prevention interventions according to socioeconomic position: a systematic review. Obes Rev 2014;15:541–54. http://dx.doi.org/10.1111/obr.12161

10. McGill R, Anwar E, Orton L, et al. Are interventions to promote healthy eating equally effective for all? Systematic review of socioeconomic inequalities in impact. BMC Public Health 2015;15:457. http://dx.doi.org/10.1186/s12889-015-1781-7