Economics Bulletin

Volume 31, Issue 4

Prevalence Rates and Racial disparities in undiagnosed pre-diabetes in the US population: Evidence from the National Health and Nutrition Examination survey of 2007-08

Achintya Ray
Tennessee State University

Abstract

Using National Health and Nutrition Examination Survey of 2007-2008, this paper presents estimates of the burden of undiagnosed pre-diabetes and racial disparities of the same in the US population. The true burden of undiagnosed pre-diabetes is found to be considerably more than the numbers estimated by the American Diabetes Association. Men are found to be more likely to have undiagnosed pre-diabetes. Prevalence rates vary considerably between different racial, gender, and age groups. There is no strong evidence that systematic racial disparities exist. There is weak evidence that members of the minority communities may have slightly lower likelihood of suffering from undiagnosed prediabetes compared to non-Hispanic whites. This evidence is more pronounced for men than for women. Higher prevalence of undiagnosed pre-diabetes among minorities especially in the early stages of lives may be partially responsible for overall racial disparities in diabetes in the country. Stopping 50% of the undiagnosed pre-diabetes cases from developing into diabetes will save US over $600 billion in current dollars.

I sincerely thank John Conley and an anonymous referee for many valuable suggestions on an earlier version of this paper. I am solely responsible for all remaining errors.

Citation: Achintya Ray, (2011) "Prevalence Rates and Racial disparities in undiagnosed pre-diabetes in the US population: Evidence from the National Health and Nutrition Examination survey of 2007-08 ", *Economics Bulletin*, Vol. 31 No. 4 pp. 3240-3252.

Contact: Achintya Ray - aray4@tnstate.edu.

Submitted: April 03, 2011. **Published:** November 25, 2011.

1. Introduction

Diabetes, a chronic condition, may be easily managed through medical intervention and lifestyle changes. Living a healthy lifestyle with appropriate diet, exercise, and healthy body weight may prevent or delay the onset of diabetes mellitus. However, many people may be unaware of the fact that they have impaired glucose metabolism. Early screening of these people may help the healthcare system to attenuate the risks of progression of diabetes and help the nation save considerable amount of healthcare dollars.(Katherine M. Flegal et al., 2010, Chaoyang Li et al., 2009, The-Emerging-Risk-Factors-Collaboration, 2011)

According to the American Diabetes Association's National Diabetes Fact Sheet, over 25.8 million people in the USA suffer from diagnosed cases of Diabetes. Prevalence of Diabetes varies widely between racial and ethnic categories. 7.1% of the non-Hispanic Whites, 12.6% of the non-Hispanic Blacks, and 11.8% of the Hispanic/Latino Americans suffered from diabetes mellitus in 2004.

This paper presents two sets of research findings: (1) prevalence rates and estimated number of undiagnosed pre-diabetes cases across many population groups distinguished by race, age, and gender, and (2) disparities in the likelihoods of having undiagnosed pre-diabetes within and between various population groups in the US.

This paper adds considerably to the figures presented by the American Diabetes Association. In doing so, I show that the true burden of future diabetes may be considerably higher than estimated by the American Diabetes Association or other professional researchers. I also present the economic implications of the numbers. I show that preventing even a fraction of undiagnosed pre-diabetes cases from progressing into fully developed diabetes cases may save the country hundreds of billions of dollars in current value.

Here are main insights (also, graphically summarized in Figure 1 whose construction will be detailed later):

First, American Diabetes Association estimates that there are about 79 million pre-diabetic cases in the US. It is shown below that the total number of undiagnosed pre-diabetes cases (91.5 million) may be considerably larger than the current estimates of the Association. In fact, it shown that the true estimates of undiagnosed pre-diabetes cases may be about 16% more that the burden of (diagnosed or undiagnosed) pre-diabetes cases estimated by the American Diabetic Association. Therefore, accounting for the number of *diagnosed* pre-diabetes cases (not included in this study) the true burden of pre-diabetes (diagnosed plus undiagnosed) may be much larger than previously believed.

Second, there seems to be a distinct gradient between different genders in the prevalence of undiagnosed pre-diabetes; men are likely to suffer from higher prevalence compared to women. This seems to be a consistent feature holding true across all racial categories. Given this result, it seems imperative that men are targeted more aggressively for screening for pre-diabetes so that appropriate medical actions may be taken and necessary lifestyle changes may be promoted at early stages of the development of the disease.

Third, the comparative advantages (lower prevalence rate of undiagnosed pre-diabetes) for non-Hispanic whites are found to be limited to the first 40 years of life. Beyond that age group, this comparative advantage largely goes away. Non-Hispanic white men and women in middle-aged or older cohorts suffer from higher prevalence rates of undiagnosed pre-diabetes compared to their minority counterparts. This result coupled with the other ones may suggest that limited healthcare resources may be well spent by screening younger minorities and middle-aged and older non-Hispanic whites more aggressively. This two pronged action may go a long way towards removing lifetime inequalities in the prevalence of diabetes and diabetes related complications.

Fourth, the overall prevalence data seems to point that people in the minority groups may not be disadvantaged in a way that is currently thought. It seems that non-Hispanic white men and women may have slightly higher prevalence of undiagnosed pre-diabetes. Overall in the population and in the age group < 40 years, African American men have lower likelihood of having undiagnosed pre-diabetes compared to non-Hispanic white men. But this does not hold true for older men.

I do not find any evidence that statistically meaningful racial disparities in undiagnosed pre-diabetes exist among women for any of the age categories considered in this paper.

It commonly believed that members of the minority communities are at disadvantage when it comes to prevalence of chronic diseases. The results presented in this paper are striking precisely because such beliefs may not always be true. It may be a fact that it is not the members of the minority communities who may be always disadvantaged but the disadvantaged community might include a substantial fraction of people from majority group. This striking finding may provide a new insight into the prevailing disparities in diabetes in the US and might form a basis for future investigations.

The rest of the paper is organized in the following way: Section 2 discusses the economic implications of diabetes and the importance of results found in this paper, Section 3 describes the data and research methods, Section 4 provides descriptions of the results and discusses their importance, and Section 5 concludes the paper.

2. Economic Burden of Diabetes and Implications of Current Findings

Diabetes is the sixth leading cause of death in the USA. Diabetes believed to have contributed to 231,404 deaths in 2007. Diabetes is a major risk factor contributing towards heart disease, stroke, hypertension, blindness, kidney disease, nervous system disease, dental disease, lower limb amputation etc. It is estimated that diabetes cost over $171 billion to the nation in 2007. [1]

The chance that a male American will develop diabetes over lifetime is 32.8%. The corresponding figure for an American woman is 38.5%. Pre-diabetes is a condition that precedes the full development of diabetes mellitus. A diagnosis of diabetes mellitus at the age of 40 could lead to an average loss of 18.6 quality adjusted life years for men and 22.0

[1] American Diabetes Association's national diabetes fact sheet may be accessed at http://www.diabetes.org/diabetes-basics/diabetes-statistics/ (Accessed March 9, 2011)

quality adjusted life years for women. (American-Diabetes-Association, 2011, Greta Kilmer et al., 2011, JW Lee et al., 2011, K. M. Venkat Narayan et al., 2003)

A recent study by the UnitedHealth Group estimates that more than 50% of Americans could have diabetes or pre-diabetes by 2020. This could cost the nation about $3.5 trillion if the current trend continues. New estimates also suggest that diabetes and pre-diabetes may account for 10% of national health expenditure in the USA by 2020. In monetary terms, healthcare expenditures attributable to diabetes and pre-diabetes may contribute upwards of $500 billion by 2020.

Considering the difference between the estimates presented by the American Diabetes Association and study performed by the UnitedHealth Group, the total cost attributable to diabetes may have gone up from $171 billion in 2007 to $194 billion in 2010. This difference translates into a 13.5% increase in 3 years.

The report by the UnitedHealth Group also estimates that a person with diagnosed diabetes consumes about $11,700 in annual healthcare costs compared to $4,400 for the remainder sections of the population. In comparison, a person with diabetes mellitus related complications may consume about $20,700 in annual healthcare costs.[2]

If about 50% of the undiagnosed pre-diabetes cases (or about 46 million people) develop into full fledged diabetes mellitus then they will consume an estimated $538 billion annually in current dollar terms. This number is easily obtained by combining the estimated number of undiagnosed pre-diabetes cases presented in the paper and the monetary costs of diabetes estimated by the studies of the UnitedHealth Group.

UnitedHealth Group also estimates that "Early Intervention to Prevent Pre-diabetes from Becoming Diabetes" can "prevent or delay the onset of the disease by 58 percent." Given the estimates presented in this paper, early interventions may be able to stop about 53 million people (who do not know that they are already suffering from pre-diabetes) from falling into fully developed cases of diabetes. This translates into a saving of about $621 billion dollars annually in current dollar terms.

Clearly, accounting for premature death, morbidity, and disability, diabetes is a costly disease and demands the action of public health authorities so that the onset of diabetes may be prevented or delayed. This may be best achieved by targeting the people who are pre-diabetic and hence, suffer from higher likelihoods of becoming diabetic.(M. Kaye Kramer et al., 2009)

Much of the success of the public health programs aimed towards prevention of diabetes or delaying its onset will depend on the ability of the programs to target the right groups so that limited healthcare resources may be directed to their most effective targets. In this regard, understanding the prevalence rates and using that information to identify the most vulnerable groups will be very important first steps.(Ronald T. Ackermann et al., 2008, K. M. Venkat

[2] "The United States of Diabetes: New Report Shows Half the Country Could Have Diabetes or Prediabetes at a Cost of $3.35 Trillion by 2020", UnitedHealth Group, Available at http://www.unitedhealthgroup.com/newsroom/news.aspx?id=36df663f-f24d-443f-9250-9dfdc97cedc5 (Accessed September 26, 2011)

Narayan, James P. Boyle, Theodore J. Thompson, Stephen W. Sorensen and David F. Williamson, 2003)

Significant racial disparities in the incidence and prevalence of diabetes pose major public health challenges in the US. Racial disparities in diabetes exacerbate the public health problem since varying prevalence rates imply unequal relative magnitudes of burdens on different races. This unequal distribution may be partially responsible for the existing health inequalities between different races in the country. Therefore, it is important that early diagnosis of diabetes, and appropriate treatments are taken up on a priority basis so that racial disparities in health outcomes may be reduced as far as practically possible.(Darcy Green Conaway et al., 2005, Linda S. Geiss et al., 2010, Ved V. Gossain and Saleh Aldasouqi, 2010, JW Lee, FL Brancati and HC Yeh, 2011, Alexander Tenenbaum et al., 2000)

Although a great deal is known about the diagnosed cases of diabetes, relatively little is known about the undiagnosed pre-diabetes cases where the affected individuals may be progressing towards developing diabetes completely unaware of their worsening health conditions. This lack of research is there despite the fact that undiagnosed pre-diabetes can pose significant threat to human health and wellbeing. (Daniela Geba and Thomas A. Pearson, 2011, Linda S. Geiss, Cherie James, Edward W. Gregg, Ann Albright, David F. Williamson and Catherine C. Cowie, 2010, Ved V. Gossain and Saleh Aldasouqi, 2010, Greta Kilmer, Elizabeth Hughes, Xuanping Zhang and Laurie Elam-Evans, 2011)

This study makes a modest effort to fill some parts this gap and seeks to draw the attention of the health policymakers so that appropriate targeting can be done to screen people proactively and reduce the burden of racial disparities in diabetes in the American population.

The estimates provided in this paper provide a new basis for estimating the economic cost of diabetes in the US economy. It can be easily seen that the current estimates may be very low compared to what might happen in the future if we take into account the burden of undiagnosed pre-diabetes in the population.

3. Data and Research Methods

Data from the National Health and Nutrition Examination Survey (NHANES) data for 2007-2008 are used to derive the prevalence rates of undiagnosed pre-diabetes and estimated number of cases of pre-diabetes in various population groups in the US. NHANES is based on a complex stratified random sampling of non-institutionalized US population and usefully contains not only recall based health information but many important laboratory test results for individuals. One of these important tests involves measurement of fasting plasma glucose levels. This information is the main one used here to identify pre-diabetic cases.

Data from demographic, diabetes, and fasting blood glucose files of NHANES 2007-08 are merged to create a comprehensive data for this study. Appropriate sample weights are used to account for the probability of selection, complex survey design, and non-response related biases to reach appropriate population level figures. Usage of the sample weights are strongly recommended in the NHANES survey guide for credible population estimates and correct

variance estimations. Sample weights provided in the fasting plasma glucose file are used to arrive at the estimations below.

A person is assumed to have undiagnosed pre-diabetes if (1) fasting plasma glucose level (after at least eight hours of fasting) is $\geq$110 mg/dL and $\leq$124 mg/dL and (2) no doctor has ever diagnosed the person as diabetic, pre-diabetic or, borderline diabetic. This definition of pre-diabetes (based on fasting plasma glucose level) is consistent with the latest guidelines issued by the American Diabetes Association.(American-Diabetes-Association, 2011) Fasting plasma glucose measurement is also a valuable indicator of underlying health and has been used in research to predict mortality or coronary heart disease among older people.(Leon A. Simons et al., 2008)

Since we use the fasting plasma glucose level to identify pre-diabetic individuals, we restrict this study for the age group for which the fasting blood glucose measurement was performed. In NHANES 2007-08, this test was only performed for a subset of individuals aged 12 and above. Children less than 12 years of age and women who are pregnant or whose pregnancy status could not be ascertained are excluded from this analysis. Also excluded from the analysis are the people whose fasting blood glucose measurement was done following less than 8 hours of fasting. The final sample through NHANES provided replication weights represent about 217 million US population aged 12 and above.

Using the demographic information, the population is further divided into 10 mutually exclusive groups: Mexican American Men, Mexican American Women, Other Hispanic Men, Other Hispanic Women, Non-Hispanic White Men, Non-Hispanic White Women, Non-Hispanic Black Men, Non-Hispanic Black Women, Other Men, and Other Women.

Each race/gender group is further divided into four mutually exclusive age categories: $\geq$12 to $\leq$20, >20 to $\leq$40, >40 to <65, and 65 and above. Prevalence rates (expressed in terms of proportion), 95% confidence interval for the prevalence rates, and estimated number of undiagnosed pre-diabetes cases are computed for each race, gender, and age categories and also for the overall population.

I used the STATA/SE 8.2 by the StataCorp to conduct these analyses. A particularly attractive feature of STATA/SE 8.2 is its ability to easily integrate complex survey design consideration in the estimation process. This is especially useful for complex stratified random sample like the NHANES. The estimation techniques relevant for complex survey are used throughout this paper. Final results are presented in Table 1. An aggregated and disaggregated (overall, within group and between group) graphical view of the prevalence data are presented in Figure 1.

Most of the prevalence rates are also accompanied with large 95% confidence intervals. Therefore, it may be difficult to conclude positively if disparities exist between different races in a statistically significant way. To test for that, odds ratios of having undiagnosed pre-diabetes are computed through maximum likelihood logistic regression for both men and women. Indicator variables are used in the regressions to derive the odds ratios for various population groups. These computations are done for six different categories: all men, all women, all men aged 40 or below, all women aged 40 and below, all men aged over 40, and all women aged over 40. Non-Hispanic white men and women are considered to be the

reference group for all these cases (hence, a default OR of 1.00). Results (odds ratios and corresponding 95% CIs) from the maximum likelihood logistic regressions are presented in Table 2.

4. Results and Discussion

Over 42.3% (95% CI: 39.05%- 45.68%) of US population aged 12 and above suffer from undiagnosed pre-diabetes. This translates into over 91.5 million people. Of these 91.5 million people, 10.5 million are between the ages 12-20, 40.15 million are non-Hispanic White men, 41.36 million are between the ages 40 – 65, and 25.75 million are non-Hispanic white women.

It is interesting to note that over 14.78 million of Medicare eligible people (aged 65 and above) may be suffering from undiagnosed pre-diabetes. This observation may be important given the natural propensity for health status to decline during the older ages. Also, people in this oldest category are far less likely to transition into any other insurance arrangement and most likely to continue to consume Medicare resources for as long as they live. Thus this number may be viewed as potentially unrecognized liability for the Medicare.

Among the children, adolescents, and young adults, 11.55% (95% CI: 8.79%- 15.04%) between the ages of 12-20 suffer from undiagnosed pre-diabetes. This prevalence rate rises to 27.11% (95% CI: 23.02%- 31.62%) for 20-40 age group, 45.19% (95% CI: 39.14%- 51.38%) for 40-65 age group and then falls considerably to 16.15% (95% CI: 14.27%- 18.23%) for the people aged 65 and above.

Also, among the children and adolescents in the age group 12-20, non Hispanic black women have the lowest prevalence of undiagnosed pre-diabetes (8.28%, 95% CI: 3.61%- 17.85%) and non Mexican American Hispanic men have the highest prevalence of undiagnosed pre-diabetes (24.15%, 95% CI: 11.31%- 44.31%).

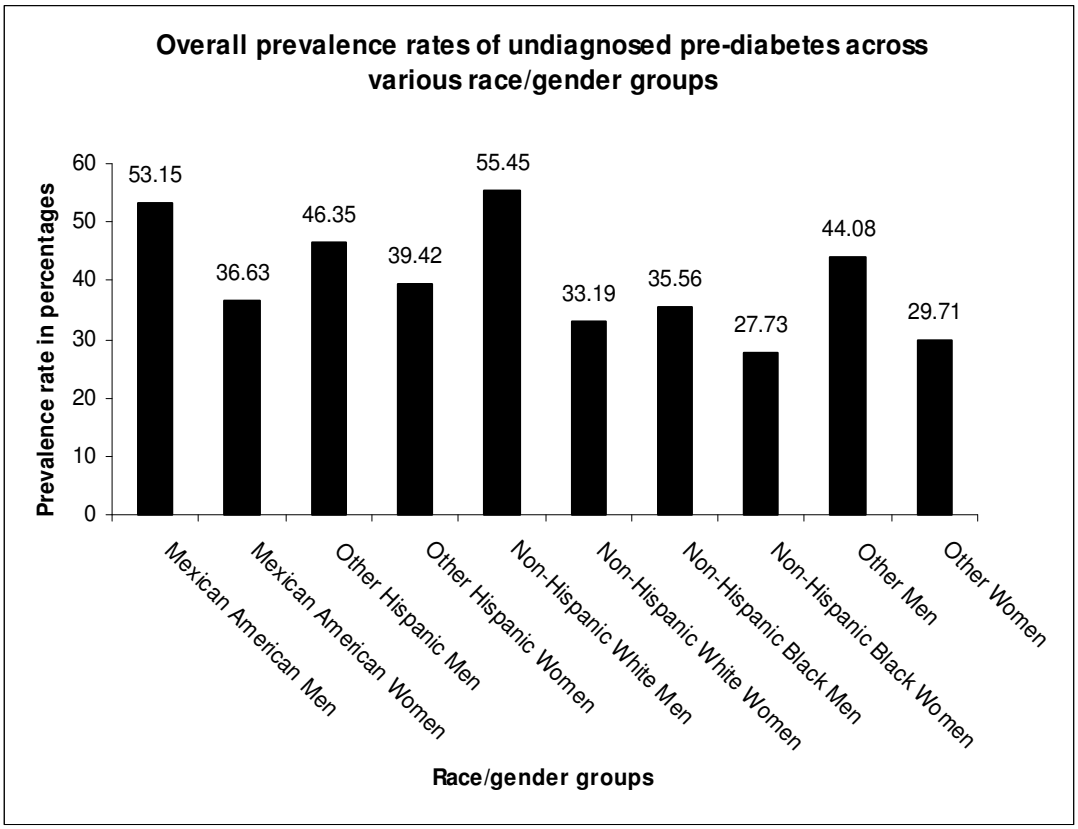
In general, women are found to have lower prevalence of undiagnosed pre-diabetes compared to men in the same racial category. Interestingly, lowest overall prevalence rate of 27.73% (95% CI: 19.52% - 37.76%) is seen in non-Hispanic black women among all the race/gender categories. Highest prevalence rate of undiagnosed pre-diabetes is found among non-Hispanic white men (55.45%, 95% CI: 51.0%- 59.81%) followed by Mexican American men (53.15%, 95% CI: 44.52%- 61.59%).

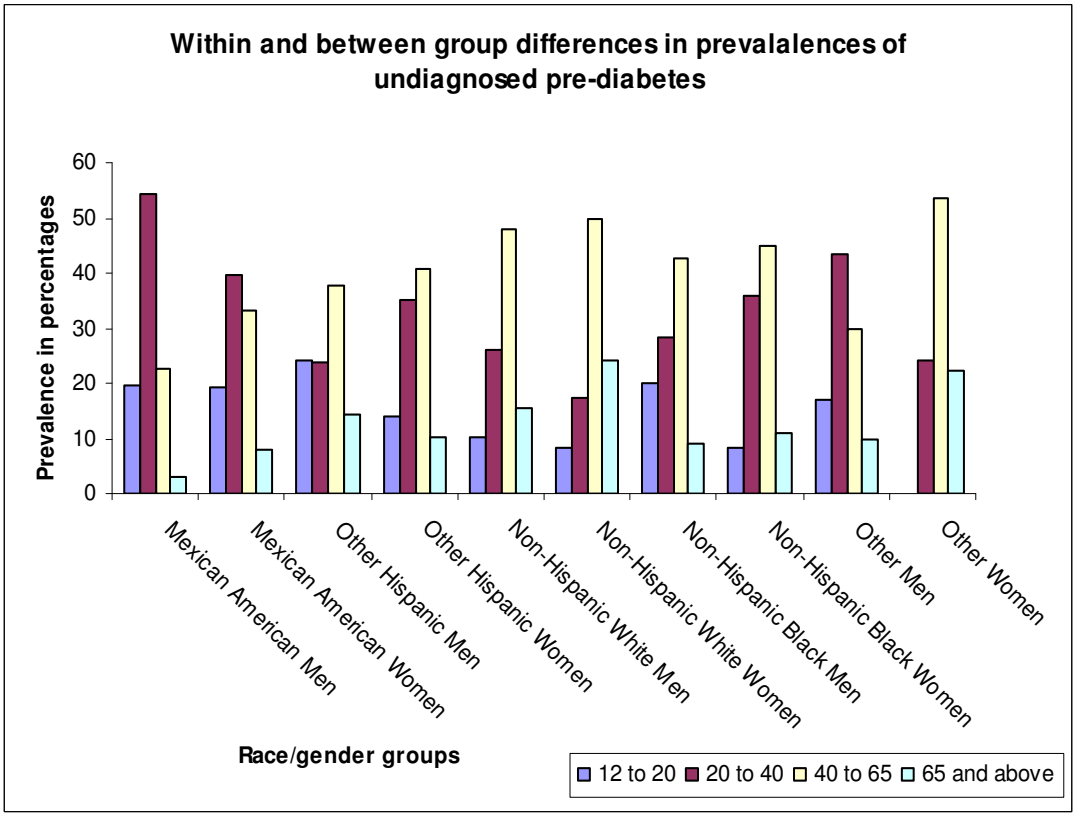
Among the men of 20-40 age group, Other Hispanic men have the lowest prevalence rate (23.8%, 95% CI: 8.98%- 49.71%) and Mexican American men have the highest prevalence (54.36%, 95% CI: 42.19%- 66.03%). This is a very interesting finding and may go to prove that it may be inappropriate to treat all Hispanic men equally when it comes to screening for pre-diabetes. There seems to be a significant difference in the prevalence rates of undiagnosed pre-diabetes between Hispanic men depending on their ancestry (Mexico vs. others.)

Table 1
Prevalence and estimated number of undiagnosed
Pre-diabetes cases across different races, genders, and age groups in the US.

Race and Gender	Age Categories				
	12 to 20	**20 to 40**	**40 to 65**	**65 and above**	**Total for the Group**
Mexican American Men	**0.198** [.1053, .3412] **1,117,341**	**0.5436** [.4219, .6603] **3,068,009**	**0.2283** [.1385, .3525] **1,288,309**	**0.0301** [.0093, .0937] **170,077**	**0.5315** [.4452, .6159] **5,643,736**
Mexican American Women	**0.1923** [.1036, .3289] **584,125**	**0.396** [.3178, .4799] **1,203,100**	**0.3324** [.2417, .4374] **1,009,713**	**0.0793** [.053, .117] **240,899**	**0.3663** [.271, .4734] **3,037,837**
Other Hispanic Men	**0.2415** [.1131, .4431] **620,048**	**0.238** [.0898, .4971] **610,861**	**0.3785** [.2359, .5457] **971,757**	**0.142** [.0584, .3063] **364,475**	**0.4635** [.3718, .5577] **2,567,141**
Other Hispanic Women	**0.1398** [.0729, .2515] **307,210**	**0.3515** [.1913, .5541] **772,400**	**0.407** [.2445, .5927] **894,147**	**0.1017** [.0381, .2445] **223,376**	**0.3942** [.2957, .5022] **2,197,134**
Non-Hispanic White Men	**0.1032** [.0619, .1673] **4,144,087**	**0.2619** [.1947, .3424] **10,514,360**	**0.4808** [.403, .5597] **19,305,074**	**0.1541** [.1218, .193] **6,185,376**	**0.5545** [.51, .5981] **40,148,896**
Non-Hispanic White Women	**0.0847** [.0464, .1497] **2,181,874**	**0.1748** [.113, .2604] **4,500,944**	**0.4993** [.3895, .6092] **12,855,245**	**0.2411** [.1659, .3367] **6,208,498**	**0.3319** [.2799, .3883] **25,746,562**
Non-Hispanic Black Men	**0.201** [.1219, .313] **785,396**	**0.2835** [.1926, .3962] **1,107,801**	**0.4254** [.2933, .5691] **1,662,555**	**0.0901** [.0434, .178] **352,295**	**0.3556** [.273, .4478] **3,908,047**
Non-Hispanic Black Women	**0.0828** [.0361, .1785] **293,728**	**0.3582** [.2678, .4599] **1,270,839**	**0.4494** [.3492, .5539] **1,594,553**	**0.1097** [.0656, .1778] **389,116**	**0.2773** [.1952, .3776] **3,548,236**
Other Men	**0.1684** [.0591, .395] **541,531**	**0.4343** [.2004, .7016] **1,396,816**	**0.2999** [.103, .6151] **964,675**	**0.0974** [.0183, .3848] **313,163**	**0.4408** [.3036, .5876] **3,216,184**
Other Women	**Not enough data to reach Meaningful Estimate**	**0.2424** [.0467, .6765] **368,716**	**0.5357** [.2406, .8078] **814,889**	**0.2219** [.1156, .3835] **337,464**	**0.2971** [.119, .5695] **1,521,069**
Total	**0.1155** [.0879, .1504] **10,575,341**	**0.2711** [.2302, .3162] **24,813,845**	**0.4519** [.3914, .5138] **41,360,918**	**0.1615** [.1427, .1823] **14,784,738**	**0.4233** [.3905, .4568] **91,534,842**

Figure 1
Overall prevalence, and within and between group variations in the prevalence rates of undiagnosed pre-diabetes in the US population aged 12 years and above





In the Medicare eligible age group (65 and above), non-Hispanic white women have the highest prevalence (24.11%, 95% CI: 16.59%- 33.67%) and Mexican-American men have the lowest prevalence of undiagnosed pre-diabetes (3.01%, 95% CI: 0.93%- 9.37%). Of the 14.78 million Medicare eligible adults (aged 65 and above) who may be suffering from undiagnosed pre-diabetes, about 12.4 million are non-Hispanic whites. Also, in the Medicare eligible age group, both non-Hispanic white men and women have higher prevalence rates compared any corresponding Hispanic categories or non-Hispanic black men and women categories.

Table 2
Relative likelihood of minorities to have undiagnosed pre-diabetes

Racial Group	**Men**	**Women**
	OR (95% CI)	**OR (95% CI)**
Overall		
Mexican American	0.91 (0.65, 1.28)	1.16 (0.71, 1.90)
Other Hispanic	0.69 (0.46, 1.04)	1.31 (0.75, 2.30)
Non-Hispanic White	**Reference Group**	**Reference Group**
Non-Hispanic Black	0.44 (0.28, 0.70)	0.77 (0.46, 1.30)
Others	0.63 (0.34, 1.19)	0.85 (0.26, 2.76)
Age less than 40 years		
Mexican American	1.26 (0.96, 1.66)	1.94 (0.94, 4.00)
Other Hispanic	0.71 (0.33, 1.55)	2.04 (0.57, 7.28)
Non-Hispanic White	**Reference Group**	**Reference Group**
Non-Hispanic Black	0.52 (0.31, 0.87)	1.11 (0.42, 2.94)
Others	0.82 (0.34, 1.95)	0.66 (0.13, 3.26)
Age 40 years or older		
Mexican American	0.94 (0.39, 2.27)	1.15 (0.75, 1.76)
Other Hispanic	0.86 (0.50, 1.50)	1.34 (0.68, 2.61)
Non-Hispanic White	**Reference Group**	**Reference Group**
Non-Hispanic Black	0.45 (0.21, 1.00)	0.79 (0.45, 1.39)
Others	0.67 (0.28, 1.63)	1.29 (0.19, 8.59)

Among the middle aged adults who are not yet Medicare eligible (40-65 age group), lowest prevalence is found among Mexican-American men (22.83%, 95% CI: 13.85%- 35.25%) and highest prevalence is found among other women (53.57%, 95% CI: 24.06%- 80.78%). In the same age group, non-Hispanic black men has lower prevalence than non-Hispanic white men and non-Hispanic black women has lower prevalence compared to non-Hispanic white women.

Results presented in table 2 suggest that there may not be any racial disparities in statistically significant ways in all but two cases. Only African American men are found to have lower likelihood of having undiagnosed pre-diabetes compared to non-Hispanic white men (OR 0.44, 95% CI: 0.28-0.70). African American men below the age of 40 are also less likely than their non-Hispanic white male counterparts to have undiagnosed pre-diabetes. But once divided into separate age categories, such advantage for non-Hispanic black men goes away for the group aged 40 and above. No racial disparities in the occurrence of undiagnosed pre-diabetes is observed among women. It may be noted that although many of the odds ratios point to the commonly believed directions, they are not statistically significant (in that the 95% CI spreads on either sides of 1.0).

5. Conclusion

National Health and Nutrition Examination data of 2007-08 shows that there are over 91.5 million Americans aged 12 and above may be living with undiagnosed pre-diabetes. This estimate is considerably more than the number of pre-diabetes cases estimated by the American Diabetes Association. Prevalence rates of undiagnosed pre-diabetes vary widely between people of different races and different genders. Overall, men are more likely to suffer from higher prevalence rates compared to women. Non-Hispanic white men are found to have the highest prevalence rate of undiagnosed pre-diabetes cases and non-Hispanic black women have the lowest prevalence rate for the same.

Prevalence rate of undiagnosed pre-diabetes steadily rises from 12 years to just before the age of 65 when most of the people expect to become Medicare eligible. For the Medicare eligible group (age 65 and above), prevalence rates fall for all race and gender groups.

There is no conclusive evidence that systematic racial disparities exist in the prevalence of undiagnosed pre-diabetes. There is weak evidence that African American men may have lower likelihood of having undiagnosed pre-diabetes compared to non-Hispanic white men but the same may not be said about women.

Reference

Ackermann, Ronald T.; Finch, Emily A.; Brizendine, Edward; Zhou, Honghong and Marrero, David G. "Translating the Diabetes Prevention Program into the Community: The Deploy Pilot Study." *American journal of preventive medicine*, 2008, *35*(4), pp. 357.

American-Diabetes-Association. "Diagnosis and Classification of Diabetes Mellitus." *Diabetes Care*, 2011, *34*(Supplement 1), pp. S62-S69.

Conaway, Darcy Green; O'Keefe, James H.; Reid, Kimberly J. and Spertus, John. "Frequency of Undiagnosed Diabetes Mellitus in Patients with Acute Coronary Syndrome." *The American Journal of Cardiology*, 2005, *96*(3), pp. 363.

Flegal, Katherine M.; Carroll, Margaret D.; Ogden, Cynthia L. and Curtin, Lester R. "Prevalence and Trends in Obesity among Us Adults, 1999–2008." *Journal of the American Medical Association*, 2010, *303*(3), pp. 235–41.

Geba, Daniela and Pearson, Thomas A. "Identification of Those at Risk for Diabetes Mellitus: Can Comparative Effectiveness Research Provide the Answer?" *American journal of preventive medicine*, 2011, *40*(1), pp. 101.

Geiss, Linda S.; James, Cherie; Gregg, Edward W.; Albright, Ann; Williamson, David F. and Cowie, Catherine C. "Diabetes Risk Reduction Behaviors among U.S. Adults with Prediabetes." *American journal of preventive medicine*, 2010, *38*(4), pp. 403.

Gossain, Ved V. and Aldasouqi, Saleh. "The Challenge of Undiagnosed Pre-Diabetes, Diabetes and Associated Cardiovascular Disease." *International Journal of Diabetes Mellitus*, 2010, *2*(1), pp. 43.

Kilmer, Greta; Hughes, Elizabeth; Zhang, Xuanping and Elam-Evans, Laurie. "Diabetes and Prediabetes: Screening and Prevalence among Adults with Coronary Heart Disease." *American journal of preventive medicine*, 2011, *40*(2), pp. 159.

Kramer, M. Kaye; Kriska, Andrea M.; Venditti, Elizabeth M.; Miller, Rachel G.; Brooks, Maria M.; Burke, Lora E.; Siminerio, Linda M.; Solano, Francis X. and Orchard, Trevor J. "Translating the Diabetes Prevention Program: A Comprehensive Model for Prevention Training and Program Delivery." *American journal of preventive medicine*, 2009, *37*(6), pp. 505.

Lee, JW; Brancati, FL and Yeh, HC. "Trends in the Prevalence of Type 2 Diabetes in Asians Versus Whites: Results from the United States National Health Interview Survey, 1997-2008." *Diabetes Care*, 2011, *34*(2), pp. 353-57.

Li, Chaoyang; Ford, Earl S.; Zhao, Guixiang; Ahluwalia, Indu B.; Pearson, William S. and Mokdad, Ali H. "Prevalence and Correlates of Undiagnosed Depression among U.S. Adults with Diabetes: The Behavioral Risk Factor Surveillance System, 2006." *Diabetes Research and Clinical Practice*, 2009, *83*(2), pp. 268.

Simons, Leon A.; Simons, Judith; Friedlander, Yechiel and McCallum, John. "Usefulness of Fasting Plasma Glucose to Predict Mortality or Coronary Heart Disease in Persons >=60 Years of Age without Diabetes Mellitus or in Those with Undiagnosed Diabetes Mellitus (from the Dubbo Study)." *The American Journal of Cardiology*, 2008, *102*(7), pp. 831.

Tenenbaum, Alexander; Motro, Michael; Fisman, Enrique Z.; Boyko, Valentina; Mandelzweig, Lori; Reicher-Reiss, Henrietta; Graff, Eran; Brunner, Daniel and Behar, Solomon. "Clinical Impact of Borderline and Undiagnosed Diabetes Mellitus in Patients with Coronary Artery Disease." *The American Journal of Cardiology*, 2000, *86*(12), pp. 1363.

The-Emerging-Risk-Factors-Collaboration. "Diabetes Mellitus, Fasting Glucose, and Risk of Cause-Specific Death." *New England Journal of Medicine*, 2011, (364), pp. 829-41.

Venkat Narayan, K. M.; Boyle, James P.; Thompson, Theodore J.; Sorensen, Stephen W. and Williamson, David F. "Lifetime Risk for Diabetes Mellitus in the United States." *Journal of the American Medical Association*, 2003, *290*(14), pp. 1884-90.