

# Appendix 1: Persistence of undiagnosed diabetes based on HbA1c or FPG, NHANES 1988-1994

Following an initial physical examination, a nonrandom subsample of participants (n=2596, 1392 female 1204 males) in the NHANES 1988-1994 were selected for a second comprehensive examination using the following criteria: (1) mainly adults (2) roughly half aged 20-39 and half aged 40+; (3) roughly half male and half female. This second examination was conducted approximately two weeks after the first and included the collection of fasting plasma glucose (FPG) and glycated hemoglobin (HbA1c) using the same standardized protocol.

Among participants that attended both examinations, we excluded participants who were pregnant, aged <20 years, had diagnosed diabetes, and those who did not have HbA1c and FPG measures from both examinations available. These exclusions resulted in an analytic sample of 679 participants.

For these participants, we calculated the proportion with an elevated HbA1c ( $\geq 6.5\%$ ) or elevated FPG ( $\geq 126$  mg/dl) during the first examination who also had an elevated HbA1c or FPG during the second examination (29/40, 73%). This percentage represents the “persistence” of an elevated test result; it suggests that approximately 73% of participants with an elevated test would have a second elevated measure if they were re-tested, as is currently recommended in clinical guidelines.

		Second exam		
		<b>No diabetes:</b> FPG<126 mg/dl and A1c<6.5%	<b>Suspected diabetes:</b> A1c $\geq$ 6.5% or FPG $\geq$ 126 mg/dl	Total
First exam	<b>No diabetes:</b> FPG<126 mg/dl and A1c<6.5%	631 (no diabetes)	8 (non-persistent)	639
	<b>Suspected diabetes:</b> A1c $\geq$ 6.5% or FPG $\geq$ 126 mg/dl	11 (non-persistent)	29 (persistent diabetes)	40
<b>29/40 = 73% (95% CI: 56-85%) persistence for elevated FPG or A1c</b>				

Because repeat HbA1c and FPG testing was only performed this subsample of participants, we could not directly compute the “persistence” of elevated HbA1c or FPG in the entire NHANES cohort. Thus, we assumed this persistence rate approximated the persistence of elevated HbA1c or FPG in the study sample. In the main analysis, we calculated the prevalence of persistent undiagnosed diabetes by determining the proportion of adults with no diagnosed diabetes and elevated HbA1c or FPG in the main NHANES sample and multiplied these estimates by the persistence rate (0.73).

Appendix 2: Age-standardized prevalence of confirmed and persistent undiagnosed diabetes, 2011-2020, by subgroups

	Confirmed undiagnosed diabetes*				Persistent undiagnosed diabetes†			
	Prevalence (SE)		Proportion (SE) of diabetes cases that is undiagnosed		Prevalence (SE)		Proportion (SE) of diabetes cases that is undiagnosed	
	2011-2020	P-val	2011-2020	P-val	2011-2020	P-val	2011-2020	P-val
Age group		0.001		<0.001		<0.001		<0.001
20-44 y	0.76 (0.11)		20.7 (2.6)		1.12 (0.14)		27.8 (3.2)	
45-64 y	1.67 (0.24)		11.0 (1.5)		2.94 (0.27)		17.8 (1.7)	
65+ y	1.72 (0.38)		7.2 (1.5)		3.39 (0.38)		13.2 (1.4)	
Sex		0.676		0.755		0.697		0.764
Female	1.33 (0.17)		14.7 (1.9)		2.13 (0.19)		18.3 (1.6)	
Male	1.24 (0.23)		14.5 (2.4)		2.34 (0.24)		16.2 (1.5)	
Race/ethnicity		<0.001		<0.001		<0.001		0.003
Non-Hispanic White	0.86 (0.16)		8.5 (1.7)		1.69 (0.18)		15.7 (1.6)	
Non-Hispanic Black	1.53 (0.31)		14.4 (2.8)		2.92 (0.35)		16.0 (1.7)	
Mexican American	3.31 (0.50)		19.5 (3.0)		4.08 (0.48)		19.4 (2.0)	
Asian American	2.59 (0.56)		29.3 (5.5)		4.03 (0.58)		24.6 (3.0)	
BMI category		<0.001		<0.001		<0.001		0.036
<25.0 kg/m <sup>2</sup>	0.53 (0.16)		8.2 (2.7)		1.04 (0.19)		17.6 (3.2)	
25.0-29.9 kg/m <sup>2</sup>	0.44 (0.08)		9.0 (2.8)		1.21 (0.16)		12.2 (1.6)	
≥30 kg/m <sup>2</sup>	2.56 (0.31)		16.7 (1.7)		3.96 (0.32)		19.8 (1.5)	
Education		<0.001		0.502		<0.001		0.721
College or more	0.54 (0.13)		12.4 (2.8)		1.50 (0.24)		16.5 (2.6)	
Some college	1.57 (0.31)		15.4 (2.6)		2.05 (0.26)		15.7 (1.9)	
High school or less	1.68 (0.22)		14.9 (2.1)		2.98 (0.25)		18.6 (1.4)	
Income-poverty ratio		0.013		0.009		0.002		0.056
≥350%	0.77 (0.17)		8.3 (1.9)		1.57 (0.22)		15.3 (2.2)	
130%-349%	1.46 (0.21)		17.9 (2.4)		2.29 (0.25)		16.7 (1.7)	

<130%	1.99 (0.35)		16.3 (2.4)		3.61 (0.37)		19.8 (1.9)	
Health insurance coverage		0.013		<0.001		0.386		<0.001
Yes	1.13 (0.14)		11.7 (1.4)		2.09 (0.15)		16.1 (1.1)	
No	2.09 (0.44)		24.1 (3.2)		3.86 (1.00)		28.8 (6.2)	
Last health care visit		<0.001		<0.001		0.329		<0.001
≤1 y ago	1.01 (0.11)		10.6 (1.2)		2.09 (0.13)		15.3 (1.0)	
>1 y ago	3.95 (1.03)		57.6 (5.6)		3.99 (0.82)		61.3 (6.6)	
Usual source of care		0.353		<0.001		0.454		<0.001
Yes	1.19 (0.15)		12.1 (1.5)		2.17 (0.16)		16.1 (1.1)	
No	2.02 (0.41)		33.4 (5.6)		2.49 (0.37)		31.3 (5.6)	

Note: All estimates are age standardized with 2017-2020 age distribution as reference.

\*Confirmed undiagnosed diabetes was defined as having no diagnosed diabetes and an elevated HbA1c ( $\geq 6.5\%$ ) and FPG ( $\geq 126$  mg/dl).

† Persistent undiagnosed diabetes was defined as having no diagnosed diabetes and an elevated HbA1c ( $\geq 6.5\%$ ) or FPG ( $\geq 126$  mg/dl) after adjusting for within-person variability in HbA1c and FPG measurement.

Appendix 3: Trends in the prevalence of undiagnosed, diagnosed, and total diabetes among US adults, 1988-2020

	1988- 1994	1999- 2000	2001- 2002	2003- 2004	2005- 2006	2007- 2008	2009- 2010	2011- 2012	2013- 2014	2015- 2016	2017- 2020	P-trend <sup>†</sup>
<b>Total diabetes (diagnosed plus undiagnosed diabetes)*</b>	7.63 (0.50)	8.36 (0.99)	10.13 (0.82)	10.31 (0.88)	10.86 (1.08)	11.65 (0.78)	11.55 (0.96)	12.05 (1.26)	12.74 (0.79)	14.10 (0.93)	15.13 (0.93)	<0.001
Diagnosed diabetes	4.57 (0.43)	5.63 (0.82)	6.58 (0.67)	7.21 (0.78)	7.88 (0.71)	8.57 (0.67)	8.48 (0.79)	9.20 (1.10)	9.99 (0.84)	11.05 (0.87)	11.67 (0.81)	<0.001
Undiagnosed diabetes	3.05 (0.26)	2.73 (0.52)	3.55 (0.37)	3.10 (0.42)	2.98 (0.62)	3.08 (0.30)	3.07 (0.41)	2.84 (0.43)	2.74 (0.35)	3.05 (0.32)	3.46 (0.35)	0.84
Proportion of total diabetes that is undiagnosed	40.0 (3.0)	32.7 (5.2)	35.0 (3.1)	30.1 (3.7)	27.4 (4.0)	26.4 (2.3)	26.6 (2.9)	23.6 (3.1)	21.5 (3.0)	21.6 (2.2)	22.9 (2.0)	<0.001

Note: Data are presented as prevalence estimates (with standard errors) unless noted.

\* Undiagnosed diabetes was defined as having no diagnosed diabetes and an elevated HbA1c ( $\geq 6.5\%$ ) or FPG ( $\geq 126$  mg/dl)

<sup>†</sup> Based on logistic regression with the midpoint of each period modeled as a linear predictor.

Appendix 4: Trends in the prevalence of undiagnosed diabetes<sup>\*</sup>, 1988-2020, by subgroup

	Prevalence (SE)		P-trend <sup>†</sup>	Proportion (SE) of diabetes cases that is undiagnosed		P-trend <sup>†</sup>
	1988-2010	2011-2020		1988-2010	2011-2020	
Age group						
20-44 y	1.10 (0.16)	1.53 (0.18)	0.07	31.8 (3.9)	34.4 (3.4)	0.72
45-64 y	3.94 (0.34)	4.02 (0.37)	0.38	28.9 (1.9)	22.9 (2.0)	<0.001
65+ y	7.28 (0.55)	4.64 (0.51)	0.01	31.3 (1.9)	17.3 (1.8)	<0.001
Sex						
Female	2.51 (0.20)	2.91 (0.25)	0.27	27.2 (2.6)	25.9 (2.3)	0.07
Male	4.41 (0.28)	3.20 (0.32)	0.02	33.8 (2.4)	27.9 (2.8)	<0.001
Race/ethnicity						
Non-Hispanic White	3.07 (0.21)	2.31 (0.24)	0.02	29.9 (3.2)	22.9 (3.0)	<0.001
Non-Hispanic Black	4.99 (0.37)	4.00 (0.48)	0.32	30.2 (2.6)	25.5 (3.0)	0.01
Mexican American	4.53 (0.38)	5.59 (0.65)	0.03	33.9 (2.6)	27.8 (2.8)	0.26
Asian American	-	5.52 (0.79)	-	-	42.3 (4.7)	-
BMI category						
<25.0 kg/m <sup>2</sup>	1.53 (0.19)	1.42 (0.26)	0.85	31.8 (5.9)	28.2 (4.7)	0.28
25.0-29.9 kg/m <sup>2</sup>	2.87 (0.23)	1.65 (0.22)	<0.001	31.5 (3.1)	22.1 (4.0)	<0.001
≥30 kg/m <sup>2</sup>	5.68 (0.37)	5.43 (0.42)	0.28	29.8 (2.1)	28.2 (2.0)	<0.001
Education						
College or more	2.15 (0.31)	2.05 (0.33)	0.79	28.7 (4.9)	29.6 (3.9)	0.11
Some college	2.89 (0.32)	2.80 (0.35)	0.63	25.3 (3.1)	24.3 (2.7)	0.06
High school or less	4.29 (0.25)	4.08 (0.33)	0.72	34.4 (2.4)	27.4 (2.6)	<0.001
Income-poverty ratio						
≥350%	2.53 (0.24)	2.15 (0.30)	0.49	32.4 (3.8)	20.4 (3.4)	<0.001
130%-349%	3.99 (0.34)	3.13 (0.33)	0.48	30.0 (3.5)	30.1 (2.7)	<0.001
<130%	3.84 (0.32)	4.95 (0.50)	0.50	28.5 (2.7)	29.3 (2.6)	0.25
Health insurance coverage						
Yes	3.20 (0.18)	2.86 (0.20)	0.09	27.2 (1.9)	24.8 (2.0)	<0.001
No	3.91 (0.54)	5.29 (1.36)	0.17	43.6 (3.7)	38.0 (4.2)	0.31
Last health care visit						
≤1 y ago	3.34 (0.19)	2.86 (0.18)	0.23	26.6 (1.9)	23.6 (1.6)	<0.001
>1 y ago	3.71 (0.50)	5.47 (1.11)	0.48	68.3 (3.8)	64.3 (5.0)	0.02
Usual source of care						
Yes	3.38 (0.19)	2.97 (0.21)	0.16	27.4 (2.1)	23.6 (1.7)	<0.001
No	3.17 (0.53)	3.41 (0.50)	0.35	61.2 (4.8)	46.4 (5.5)	<0.001

Note: All estimates are age standardized with 2017-2020 age distribution as reference.

<sup>\*</sup> Undiagnosed diabetes was defined as having no diagnosed diabetes and an elevated HbA1c (≥6.5%) or FPG (≥126 mg/dl)

<sup>†</sup> Based on logistic regression with the midpoint of each period modeled as a linear predictor.