Supplementary Online Content

Wang T, Lu J, Su Q, et al; 4C Study Group. Ideal cardiovascular health metrics and major cardiovascular events in patients with prediabetes and diabetes. *JAMA Cardiol*. Published online July 31, 2019. doi:10.1001/jamacardio.2019.2499

eTable 1. Definitions of 7 Ideal Cardiovascular Health Metrics in Participants With Prediabetes or Diabetes

eTable 2. Risk of CVD Events and High HbA1c According to BMI Categories Defined by Different Cutoff Points

eTable 3. Hazard Ratio (95% CI) of CVD Events Among Participants With Prediabetes or Diabetes, as Compared With Participants With Normal Glucose Regulation

eTable 4. Hazard Ratio (95% CI) of CVD Events According to Combined Ideal Cardiovascular Health Metrics Among Participants With Normal Glucose Regulation, Prediabetes, and Diabetes

eTable 5. Hazard Ratio (95% CI) of Non-fatal CVD Events and CVD Mortality According to Individual and Combined Ideal Cardiovascular Health Metrics Among Participants With Prediabetes or Diabetes Compared With Participants With Normal Glucose Regulation

eTable 6. Hazard Ratio (95% CI) of Non-fatal CVD Events and CVD Mortality According to Individual and Combined Ideal Cardiovascular Health Metrics Among Participants With Prediabetes or Diabetes

This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Definitions of 7 ideal cardiovascular health metrics in participants with prediabetes or diabetes [a]

Cardiovascular health metrics	Ideal level
Smoking	Never or quit >12 months
Body mass index	< 23 kg/m^2
Physical activity	≥ 150 min/week moderate intensity or ≥ 75 min/week vigorous intensity or ≥ 150 min/week moderate + vigorous intensity
Healthy diet	Fruits and vegetables intake ≥ 4.5 cups/day
Total cholesterol	< 200 mg/dL (untreated)
Blood pressure	< 120/<80 mm Hg (untreated)
Glycated hemoglobin A1c	
For prediabetes	< 5.7%
For diabetes	< 6.5%

[a] Definitions were adapted from the recommendations of the Goals and Metrics Committee of the Strategic Planning Task Force of the American Heart Association.[1]

Reference:

1. Lloyd-Jones DM, Hong Y, Labarthe D, et al; American Heart Association Strategic Planning Task Force and Statistics Committee. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic Impact Goal through 2020 and beyond. Circulation 2010; 121:586-613.

eTable 2. Risk of CVD events and high HbA1c according to BMI categories defined by different cutoff points

Analysis	BMI (kg/m^2)			
	< 23 (n=37590)	23-< 24 (n=13464)	24-< 25 (n=13469)	≥ 25 (n=47242)
Association between BMI and CVD events				
CVD cases, n (%)	798 (2.1)	324 (2.4)	346 (2.6)	1414 (3.0)
HR (95% CI) [a]	1.00 (Ref.)	1.10 (0.96-1.25)	1.10 (0.97-1.25)	1.19 (1.09-1.30)
Association between BMI and high HbA1c (≥ 6.5)				
High HbA1c, n (%)	3365 (9.0)	1699 (12.6)	2071 (15.4)	9918 (21.0)
OR (95% CI) [b]	1.00 (Ref.)	1.41 (1.32-1.50)	1.71 (1.61-1.82)	2.41 (2.31-2.52)

Analysis	BMI (kg/m^2)		
	≥ 23 vs. < 23	≥ 24 vs. < 24	≥ 25 vs. < 25
Association between BMI and CVD events			
HR (95% CI) [a]	1.16 (1.06-1.26)	1.14 (1.05-1.23)	1.14 (1.05-1.22)
Association between BMI and high HbA1c (≥ 6.5)			
OR (95% CI) [b]	2.08 (1.99-2.17)	2.02 (1.95-2.10)	1.94 (1.88-2.01)

[a] HR (95% CI) for incident CVD events, which were adjusted for age, sex, education attainment (below high school, high school or above), family history of diabetes (yes or no), family history of CVD (yes or no), smoking status (ideal or not), physical activity (ideal or not), healthy diet (ideal or not), total cholesterol (ideal or not), blood pressure (ideal or not), and HbA1c (ideal or not).

[b] OR (95% CI) for high HbA1c at baseline, which were adjusted for age, sex, education attainment (below high school, high school or above), family history of diabetes (yes or no), family history of CVD (yes or no), smoking status (ideal or not), physical activity (ideal or not), healthy diet (ideal or not), total cholesterol (ideal or not), and blood pressure (ideal or not).

eTable 3. Hazard ratio (95% CI) of CVD events among participants with prediabetes or diabetes, as compared with participants with normal glucose regulation [a]

Category	Person-years	Cases	Unadjusted HR (95% CI)	Multivariable-adjusted HR (95% CI) [b]
Normal glucose regulation	92244	453	1.00	1.00
Prediabetes	220763	1322	1.23 (1.11-1.37)	0.98 (0.88-1.09)
Diabetes	93058	1107	2.45 (2.20-2.73)	1.56 (1.40-1.75)

[a] 111765 participants (24881 with normal glucose regulation, 61024 with prediabetes, and 25860 with diabetes) were included in the analysis.

[b] Adjusted for age, sex, education attainment (below high school, high school or above), family history of diabetes (yes or no), and family history of CVD (yes or no).

eTable 4. Hazard ratio (95% CI) of CVD events according to combined ideal cardiovascular health metrics among participants with normal glucose regulation, prediabetes, and diabetes [a]

Category	Person-years	Cases	HR (95% CI) [b]
Normal glucose regulation			
Number of ideal cardiovascular health metrics			
≤ 1	1992	14	1.00
2	12602	109	1.18 (0.67-2.07)
3	24979	150	0.90 (0.51-1.57)
4	26643	122	0.79 (0.45-1.39)
≥ 5	26028	58	0.52 (0.28-0.94)
Each 1-number increment in ideal metrics	-	-	0.81 (0.74-0.88)
Prediabetes			
Number of ideal cardiovascular health metrics			
≤ 1	32967	307	1.00
2	60272	436	0.80 (0.69-0.93)
3	64473	351	0.66 (0.56-0.77)
4	42146	174	0.55 (0.46-0.67)
≥ 5	20906	54	0.42 (0.32-0.57)
Each 1-number increment in ideal metrics	-	-	0.82 (0.79-0.86)
Diabetes			
Number of ideal cardiovascular health metrics			
≤ 1	17554	272	1.00
2	28819	366	0.81 (0.69-0.95)
3	26777	305	0.74 (0.63-0.87)
4	14000	133	0.64 (0.52-0.79)
≥ 5	5909	31	0.39 (0.27-0.56)
Each 1-number increment in ideal metrics	-	-	0.85 (0.80-0.89)

[a] 111765 participants (24881 with normal glucose regulation, 61024 with prediabetes, and 25860 with diabetes) were included in the analysis.

[b] Adjusted for age, sex, education attainment (below high school, high school or above), family history of diabetes (yes or no), and family history of CVD (yes or no). The P value for interaction between the number of ideal cardiovascular health metrics and diabetes status on CVD events was 0.088.

eTable 5. Hazard ratio (95% CI) of non-fatal CVD events and CVD mortality according to individual and combined ideal cardiovascular health metrics among participants with prediabetes or diabetes, as compared with participants with normal glucose regulation [a]

Category	Non-fatal CVD events			CVD mortality		
	Person-years	Cases	HR (95% CI) [b]	Person-years [c]	Cases	HR (95% CI) [b]
Normal glucose regulation	92244	385	1.00	92844	68	1.00
Prediabetes						
Ideal smoking status	178928	847	0.85 (0.74-0.99)	180119	170	1.14 (0.82-1.58)
Ideal body mass index	74792	296	0.76 (0.64-0.91)	75193	87	1.32 (0.92-1.87)
Physical activity at goal	32903	135	0.75 (0.61-0.93)	33075	22	0.95 (0.57-1.58)
Healthy diet	101942	430	0.79 (0.67-0.93)	102554	78	1.01 (0.70-1.45)
Untreated total cholesterol < 200 mg/dl	122210	517	0.81 (0.70-0.95)	122920	115	1.15 (0.82-1.61)
Untreated blood pressure < 120/80 mm Hg	58472	134	0.55 (0.45-0.69)	58631	22	0.72 (0.43-1.21)
Glycated hemoglobin A1c < 5.7%	50843	251	0.98 (0.83-1.15)	51195	60	1.39 (0.98-1.97)
Number of ideal cardiovascular health metrics						
$\leq$ 1	32967	262	1.40 (1.20-1.64)	33371	45	1.17 (0.80-1.70)
2	60272	352	1.06 (0.92-1.23)	60775	84	1.28 (0.93-1.77)
3	64473	290	0.88 (0.75-1.02)	64893	61	1.05 (0.74-1.48)
4	42146	146	0.74 (0.61-0.89)	42323	28	0.85 (0.54-1.31)
$\geq$ 5	20906	44	0.52 (0.38-0.72)	20959	10	0.89 (0.46-1.73)
Diabetes						
Ideal smoking status	74324	672	1.25 (1.08-1.45)	75357	174	1.82 (1.32-2.49)
Ideal body mass index	20848	164	1.20 (0.99-1.46)	21099	71	2.51 (1.76-3.57)
Physical activity at goal	12868	109	1.22 (0.97-1.53)	13074	28	2.01 (1.27-3.21)
Healthy diet	41844	354	1.22 (1.04-1.44)	42371	96	1.95 (1.38-2.75)
Untreated total cholesterol < 200 mg/dl	45014	378	1.24 (1.06-1.45)	45590	105	1.89 (1.35-2.63)
Untreated blood pressure < 120/80 mm Hg	13418	50	0.73 (0.54-0.99)	13477	21	2.08 (1.26-3.45)
Glycated hemoglobin A1c < 6.5%	31659	259	1.23 (1.05-1.44)	32083	78	1.81 (1.30-2.52)

Number of ideal cardiovascular health metrics						
≤ 1	17554	225	2.11 (1.79-2.50)	17890	47	1.97 (1.36-2.87)
2	28819	295	1.65 (1.41-1.92)	29282	71	1.70 (1.21-2.39)
3	26777	236	1.43 (1.21-1.68)	27138	69	1.80 (1.28-2.53)
4	14000	100	1.19 (0.95-1.49)	14167	33	1.98 (1.30-3.00)
≥ 5	5909	21	0.66 (0.43-1.03)	5934	10	1.60 (0.82-3.12)

[a] 111765 participants (24881 with normal glucose regulation, 61024 with prediabetes, and 25860 with diabetes) were included in the analysis.

[b] Adjusted for age, sex, education attainment (below high school, high school or above), family history of diabetes (yes or no), and family history of CVD (yes or no). Individual cardiovascular health metrics were mutually adjusted.

[c] Person-years for CVD mortality was longer than that for non-fatal CVD events, because participants may have experienced more than one CVD event.

eTable 6. Hazard ratio (95% CI) of non-fatal CVD events and CVD mortality according to individual and combined ideal cardiovascular health metrics among participants with prediabetes or diabetes [a]

Category	Non-fatal CVD events			CVD mortality		
	Person-years	Cases	HR (95% CI) [b]	Person-years [c]	Cases	HR (95% CI) [b]
Prediabetes						
Smoking status						
Non-ideal	41835	247	1.00	42202	58	1.00
Ideal	178928	847	0.80 (0.67-0.96)	180119	170	0.79 (0.56-1.12)
Body mass index						
Non-ideal	145971	798	1.00	147127	141	1.00
Ideal	74792	296	0.77 (0.67-0.89)	75193	87	1.16 (0.88-1.52)
Physical activity						
Non-ideal	187860	959	1.00	189245	206	1.00
Ideal	32903	135	0.82 (0.69-0.99)	33075	22	0.81 (0.52-1.26)
Healthy diet						
Non-ideal	118821	664	1.00	119767	150	1.00
Ideal	101941	430	0.84 (0.75-0.96)	102554	78	0.80 (0.60-1.05)
Total cholesterol						
Non-ideal	98553	577	1.00	99400	113	1.00
Ideal	122210	517	0.82 (0.72-0.92)	122920	115	0.90 (0.69-1.18)
Blood pressure						
Non-ideal	162291	960	1.00	163689	206	1.00
Ideal	58472	134	0.57 (0.47-0.69)	58631	22	0.62 (0.39-0.97)
Glycated hemoglobin A1c						
Non-ideal	169920	843	1.00	171126	168	1.00
Ideal	50843	251	1.08 (0.93-1.24)	51195	60	1.30 (0.97-1.76)
Number of ideal cardiovascular health metrics						
≤ 1	32967	262	1.00	33371	45	1.00

2	60272	352	0.75 (0.64-0.88)	60775	84	1.09 (0.76-1.57)
3	64473	290	0.62 (0.52-0.73)	64893	61	0.90 (0.61-1.32)
4	42146	146	0.52 (0.42-0.64)	42323	28	0.74 (0.46-1.18)
≥ 5	20906	44	0.37 (0.27-0.51)	20959	10	0.81 (0.41-1.61)
Each 1-number increment in ideal metrics	-	-	0.81 (0.77-0.85)	-	-	0.92 (0.82-1.03)
Diabetes						
Smoking status						
Non-ideal	18734	205	1.00	19054	56	1.00
Ideal	74324	672	0.83 (0.68-0.99)	75357	174	0.77 (0.54-1.10)
Body mass index						
Non-ideal	72210	713	1.00	73311	159	1.00
Ideal	20848	164	0.86 (0.73-1.03)	21099	71	1.51 (1.13-2.01)
Physical activity						
Non-ideal	80190	768	1.00	81336	202	1.00
Ideal	12868	109	0.90 (0.74-1.10)	13074	28	0.97 (0.65-1.44)
Healthy diet						
Non-ideal	51214	523	1.00	52039	134	1.00
Ideal	41844	354	0.88 (0.77-1.01)	42371	96	0.93 (0.72-1.22)
Total cholesterol						
Non-ideal	48044	499	1.00	48821	125	1.00
Ideal	45014	378	0.82 (0.72-0.94)	45590	105	0.86 (0.66-1.13)
Blood pressure						
Non-ideal	79641	827	1.00	80933	209	1.00
Ideal	13417	50	0.45 (0.34-0.61)	13477	21	0.94 (0.59-1.48)
Glycated hemoglobin A1c						
Non-ideal	61400	618	1.00	62328	152	1.00
Ideal	31658	259	0.82 (0.71-0.95)	32083	78	0.93 (0.70-1.22)
Number of ideal cardiovascular health metrics						
≤ 1	17554	225	1.00	17890	47	1.00

2	28819	295	0.79 (0.66-0.94)	29282	71	0.90 (0.62-1.31)
3	26777	236	0.69 (0.57-0.83)	27138	69	0.95 (0.65-1.37)
4	14000	100	0.57 (0.45-0.73)	14167	33	1.01 (0.64-1.57)
≥ 5	5909	21	0.31 (0.20-0.49)	5934	10	0.80 (0.40-1.58)
Each 1-number increment in ideal metrics	-	-	0.81 (0.77-0.86)	-	-	0.98 (0.88-1.10)

[a] 61024 participants with prediabetes and 25860 with diabetes were included in the analysis.

[b] Adjusted for age, sex, education attainment (below high school, high school or above), family history of diabetes (yes or no), and family history of CVD (yes or no). Individual cardiovascular health metrics were mutually adjusted.

[c] Person-years for CVD mortality was longer than that for non-fatal CVD events, because participants may have experienced more than one CVD event.