

**Supplementary Table 1 Baseline characteristics of participants excluded from our study by categories of serum MMA levels.** Data are shown as median  $\pm$  interquartile range. PSM: propensity score matching; MMA, methylmalonic acid; CAD, coronary artery disease; BUN, blood urea nitrogen; eGFR, estimated glomerular filtration rate; HDL-C, high-density lipoprotein cholesterol; AAC, abdominal aortic calcification.

<b>Characteristic</b>	<b>Overall, N = 2961<sup>1</sup></b>	<b>Low MMA, N = 2651<sup>1</sup></b>	<b>High MMA, N = 310<sup>1</sup></b>	<b>p-value<sup>2</sup></b>
Methylmalonic acid (nmol/L)	138 (107, 178)	130 (104, 163)	320 (274, 412)	<0.001
Age (years)	33 (26, 46)	33 (25, 41)	55 (33, 72)	<0.001
Female (%)	1,540 (51%)	1,377 (50%)	163 (54%)	0.3
Race (%)				<0.001
Non-Hispanic White	1,195 (60%)	1,011 (58%)	184 (77%)	
Non-Hispanic Black	605 (12%)	568 (13%)	37 (6.1%)	
Other	1,161 (28%)	1,072 (29%)	89 (16%)	
Education (%)				0.3
Less than high school	639 (17%)	556 (16%)	83 (19%)	
High school or above	2,187 (83%)	1,967 (84%)	220 (81%)	
Body mass index (kg/m <sup>2</sup> )				0.9
Normal weight	958 (32%)	864 (32%)	94 (32%)	
Overweight	1,936 (68%)	1,735 (68%)	201 (68%)	
Hypertension (%)	812 (26%)	661 (24%)	151 (49%)	<0.001
Diabetes (%)	267 (7.9%)	192 (6.3%)	75 (22%)	<0.001
Smoker (%)	1,207 (42%)	1,052 (41%)	155 (49%)	0.083
CAD (%)	81 (2.6%)	55 (2.0%)	26 (7.5%)	<0.001
Serum B12 (pg/ml)	496 (374, 668)	507 (385, 671)	388 (293, 578)	<0.001
Serum folate (ng/ml)	17 (12, 23)	17 (12, 23)	17 (11, 26)	0.4
Serum calcium (mg/dL)	9.40 (9.20, 9.70)	9.40 (9.20, 9.70)	9.40 (9.20, 9.60)	0.14
Serum phosphorus (mg/dL)	3.80 (3.50, 4.20)	3.80 (3.50, 4.20)	4.00 (3.60, 4.40)	0.016
Uric acid (mg/dL)	5.30 (4.40, 6.30)	5.30 (4.40, 6.30)	5.50 (4.60, 6.80)	0.016
Total cholesterol (mg/dL)	180 (157, 207)	180 (157, 206)	184 (157, 207)	0.7

<b>Characteristic</b>	<b>Overall, N = 2961<sup>1</sup></b>	<b>Low MMA, N = 2651<sup>1</sup></b>	<b>High MMA, N = 310<sup>1</sup></b>	<b>p-value<sup>2</sup></b>
BUN (mg/dL)	12 (9, 15)	11 (9, 14)	15 (11, 22)	<0.001
Serum creatinine (mg/dL)	0.84 (0.71, 0.99)	0.83 (0.70, 0.98)	0.96 (0.79, 1.14)	<0.001
Urine creatinine (mg/dL)	116 (64, 177)	118 (65, 179)	110 (63, 163)	0.072
eGFR (mL/min/1.73 m <sup>3</sup> )	93 (79, 107)	94 (81, 108)	74 (52, 94)	<0.001
HDL-C (mg/dL)	49 (40, 60)	49 (40, 60)	49 (41, 60)	0.7
Hemoglobin (g/dL)	14.20 (13.16, 15.30)	14.30 (13.30, 15.30)	13.60 (12.60, 14.70)	0.002
Serum 25(OH)D (nmol/L)	61 (46, 78)	61 (47, 77)	65 (46, 90)	0.062
Folic acid intake (mcg)	153 (90, 250)	152 (91, 248)	159 (88, 252)	0.5
Vitamin B12 intake (mcg)	4.2 (2.7, 6.4)	4.3 (2.7, 6.4)	3.5 (2.0, 6.3)	0.027
AAC (%)	174 (34%)	138 (33%)	36 (43%)	0.079

<sup>1</sup>median (IQR) for continuous; n (%) for categorical

<sup>2</sup>Wilcoxon rank-sum test for complex survey samples; chi-squared test with Rao & Scott's second-order correction

**Supplementary Table 2 Baseline characteristics of participants from NHANES 2013-2014 by categories of AAC.** Data are shown as median  $\pm$  interquartile range. PSM: propensity score matching; MMA, methylmalonic acid; CAD, coronary artery disease; BUN, blood urea nitrogen; eGFR, estimated glomerular filtration rate; HDL-C, high-density lipoprotein cholesterol; AAC, abdominal aortic calcification.

	Before PSM				After PSM		
	Overall, N = 2483 <sup>1</sup>	AAC-Free, N = 1751 <sup>1</sup>	AAC, N = 732 <sup>1</sup>	p-value <sup>2</sup>	Overall, N = 1236 <sup>1</sup>	AAC-Free, N = 618 <sup>1</sup>	AAC, N = 618 <sup>1</sup>
	157 (122, 204)	152 (118, 196)	170 (133, 229)	<0.001	160 (125, 210)	158 (121, 202)	164 (131, 210)
	56 (48, 66)	54 (47, 62)	65 (55, 74)	<0.001	62 (53, 70)	61 (52, 70)	62 (53, 71)
	1,316 (53%)	942 (53%)	374 (52%)	0.5	630 (51%)	317 (52%)	313 (50%)
				0.019			
	1,162 (73%)	743 (71%)	419 (78%)		628 (77%)	292 (76%)	336 (77%)
	469 (9.4%)	360 (10%)	109 (7.1%)		217 (7.9%)	117 (8.2%)	100 (7.6%)
	852 (17%)	648 (19%)	204 (14%)		391 (15%)	209 (16%)	182 (15%)
				0.2			
	502 (14%)	346 (13%)	156 (16%)		259 (14%)	124 (13%)	135 (16%)
	1,981 (86%)	1,405 (87%)	576 (84%)		977 (86%)	494 (87%)	483 (84%)
				0.7			
	675 (27%)	465 (26%)	210 (27%)		321 (24%)	148 (21%)	173 (26%)
	1,808 (73%)	1,286 (74%)	522 (73%)		915 (76%)	470 (79%)	445 (74%)

	Before PSM				After PSM		
	Overall, N = 2483 <sup>1</sup>	AAC-Free, N = 1751 <sup>1</sup>	AAC, N = 732 <sup>1</sup>	p-value <sup>2</sup>	Overall, N = 1236 <sup>1</sup>	AAC-Free, N = 618 <sup>1</sup>	AAC, N = 618 <sup>1</sup>
	1,174 (44%)	726 (38%)	448 (59%)	<0.001	652 (49%)	293 (43%)	359 (56%)
	397 (12%)	248 (10%)	149 (17%)	0.002	225 (15%)	99 (13%)	126 (17%)
	1,126 (45%)	730 (41%)	396 (55%)	0.003	618 (50%)	267 (42%)	351 (58%)
	135 (5.0%)	57 (3.3%)	78 (9.5%)	<0.001	84 (6.4%)	27 (4.4%)	57 (8.5%)
	518 (385, 720)	520 (384, 715)	512 (389, 732)	0.9	515 (384, 736)	522 (381, 761)	504 (385, 719)
	20 (13, 29)	19 (12, 28)	20 (14, 32)	0.001	20 (13, 29)	21 (13, 29)	20 (13, 30)
	9.40 (9.20, 9.70)	9.40 (9.20, 9.60)	9.49 (9.20, 9.70)	0.2	9.40 (9.20, 9.70)	9.40 (9.20, 9.70)	9.50 (9.30, 9.70)
	3.80 (3.40, 4.20)	3.80 (3.40, 4.20)	3.80 (3.40, 4.20)	0.6	3.80 (3.40, 4.20)	3.80 (3.40, 4.20)	3.70 (3.40, 4.10)
	5.30 (4.40, 6.20)	5.20 (4.40, 6.20)	5.50 (4.60, 6.40)	0.011	5.40 (4.50, 6.30)	5.22 (4.50, 6.10)	5.50 (4.60, 6.40)
	193 (166, 220)	195 (166, 220)	190 (166, 220)	0.2	191 (164, 220)	192 (161, 219)	191 (167, 220)
	13 (11, 17)	13 (11, 16)	15 (11, 18)	<0.001	14 (11, 18)	14 (11, 17)	14 (11, 18)
	0.88 (0.75, 1.02)	0.87 (0.74, 1.00)	0.90 (0.76, 1.09)	0.004	0.89 (0.76, 1.05)	0.88 (0.76, 1.03)	0.90 (0.76, 1.04)
	87 (48, 141)	88 (48, 146)	85 (52, 131)	0.2	87 (51, 136)	87 (49, 140)	88 (52, 132)
	79 (67, 90)	80 (69, 91)	75 (63, 87)	<0.001	77 (65, 88)	78 (66, 88)	76 (64, 88)
	52 (43, 65)	52 (43, 65)	50 (42, 62)	0.033	52 (43, 63)	53 (43, 65)	50 (42, 62)
	14.10 (13.30, 15.00)	14.10 (13.30, 15.00)	14.20 (13.20, 15.00)	0.9	14.30 (13.30, 15.00)	14.20 (13.30, 15.00)	14.30 (13.30, 15.00)
	73 (57, 91)	72 (56, 91)	76 (59, 93)	0.2	75 (58, 92)	74 (58, 92)	75 (57, 91)
	134 (77, 220)	136 (77, 223)	128 (74, 205)	0.5	133 (74, 219)	137 (73, 228)	128 (75, 204)

	Before PSM				After PSM		
	Overall, N = 2483 <sup>1</sup>	AAC-Free, N = 1751 <sup>1</sup>	AAC, N = 732 <sup>1</sup>	p-value <sup>2</sup>	Overall, N = 1236 <sup>1</sup>	AAC-Free, N = 618 <sup>1</sup>	AAC, N = 618 <sup>1</sup>
	3.9 (2.5, 5.9)	4.0 (2.6, 6.1)	3.6 (2.4, 5.8)	0.045	3.8 (2.5, 5.9)	4.1 (2.6, 6.3)	3.5 (2.4, 5.7)
	363 (14%)	206 (11%)	157 (21%)	<0.001	216 (16%)	95 (13%)	121 (19%)

continuous; n (%) for categorical

test for complex survey samples; chi-squared test with Rao & Scott's second-order correction

Supplementary Table 3 Baseline characteristics of participants with Kauppila score  $\geq 1$  by categories of serum MMA levels. Data are shown as median  $\pm$  interquartile range. PSM: propensity score matching; MMA, methylmalonic acid; CAD, coronary artery disease; BUN, blood urea nitrogen; eGFR, estimated glomerular filtration rate; HDL-C, high-density lipoprotein cholesterol; AAC, abdominal aortic calcification.

<b>Characteristic</b>	<b>Overall, N = 732<sup>1</sup></b>	<b>Low MMA, N = 575<sup>1</sup></b>	<b>High MMA, N = 157<sup>1</sup></b>	<b>p-value<sup>2</sup></b>
Methylmalonic acid (nmol/L)	170 (133, 229)	155 (126, 182)	313 (270, 406)	<0.001
Age (years)	65 (55, 74)	63 (53, 73)	70 (59, 80)	<0.001
Female (%)	374 (52%)	300 (53%)	74 (49%)	0.5
Race (%)				0.014
Non-Hispanic White	419 (78%)	312 (77%)	107 (85%)	
Non-Hispanic Black	109 (7.1%)	97 (8.0%)	12 (3.8%)	
Other	204 (14%)	166 (15%)	38 (12%)	
Education (%)				0.15
Less than high school	156 (16%)	112 (14%)	44 (20%)	
High school or above	576 (84%)	463 (86%)	113 (80%)	
Body mass index (kg/m <sup>2</sup> )				0.026
Normal weight	210 (27%)	160 (25%)	50 (35%)	
Overweight	522 (73%)	415 (75%)	107 (65%)	
Hypertension (%)	448 (59%)	343 (58%)	105 (64%)	0.3
Diabetes (%)	149 (17%)	109 (15%)	40 (24%)	0.059
Smoker (%)	396 (55%)	312 (55%)	84 (57%)	0.6
CAD (%)	78 (9.5%)	55 (9.3%)	23 (10%)	0.7
Serum B12 (pg/ml)	512 (389, 732)	540 (416, 746)	419 (283, 613)	<0.001
Serum folate (ng/ml)	20 (14, 32)	20 (14, 31)	21 (13, 35)	0.8
Serum calcium (mg/dL)	9.49 (9.20, 9.70)	9.40 (9.20, 9.70)	9.50 (9.20, 9.70)	0.4

<b>Characteristic</b>	<b>Overall, N = 732<sup>1</sup></b>	<b>Low MMA, N = 575<sup>1</sup></b>	<b>High MMA, N = 157<sup>1</sup></b>	<b>p-value<sup>2</sup></b>
Serum phosphorus (mg/dL)	3.80 (3.40, 4.20)	3.70 (3.40, 4.10)	3.80 (3.40, 4.20)	0.2
Uric acid (mg/dL)	5.50 (4.60, 6.40)	5.40 (4.50, 6.30)	5.80 (4.80, 6.80)	0.009
Total cholesterol (mg/dL)	190 (166, 220)	191 (169, 222)	179 (155, 208)	0.023
BUN (mg/dL)	15 (11, 18)	14 (11, 17)	17 (13, 23)	0.010
Serum creatinine (mg/dL)	0.90 (0.76, 1.09)	0.88 (0.76, 1.05)	1.04 (0.82, 1.33)	0.005
Urine creatinine (mg/dL)	85 (52, 131)	85 (52, 131)	85 (45, 129)	>0.9
eGFR (mL/min/1.73 m <sup>3</sup> )	75 (63, 87)	76 (65, 88)	64 (48, 79)	<0.001
HDL-C (mg/dL)	50 (42, 62)	51 (43, 63)	48 (40, 60)	0.3
Hemoglobin (g/dL)	14.20 (13.20, 15.00)	14.20 (13.20, 15.10)	14.01 (12.80, 14.70)	0.093
Serum 25(OH)D (nmol/L)	76 (59, 93)	76 (60, 92)	80 (51, 101)	0.8
Folic acid intake (mcg)	128 (74, 205)	128 (74, 204)	127 (76, 210)	0.8
Vitamin B12 intake (mcg)	3.6 (2.4, 5.8)	3.6 (2.5, 5.7)	3.5 (2.3, 5.6)	0.6
SAAC (%)	223 (27%)	151 (24%)	72 (40%)	0.002

<sup>1</sup>median (IQR) for continuous; n (%) for categorical

<sup>2</sup>Wilcoxon rank-sum test for complex survey samples; chi-squared test with Rao & Scott's second-order correction

Supplementary Table 4 Univariate logistic regression and multivariate logistic regression analyses for SAAC. SAAC, severe abdominal aortic calcification; OR, odds ratio; 95%CI, 95% confident interval; MMA, methylmalonic acid; CAD, coronary artery disease; BUN, blood urea nitrogen; eGFR, estimated glomerular filtration rate; HDL-C, high-density lipoprotein cholesterol; AAC, abdominal aortic calcification.

Characteristic	Univariate regression			Multivariate regression		
	OR <sup>1</sup>	95% CI <sup>1</sup>	p-value	OR <sup>1</sup>	95% CI <sup>1</sup>	p-value
Age	1.09	1.07, 1.11	< <b>0.001</b>	1.09	1.03, 1.16	<b>0.022</b>
Female	1.25	0.70, 2.22	0.425			
Race						
Non-Hispanic White	—	—				
Non-Hispanic Black	0.61	0.35, 1.05	0.073			
Other	0.84	0.49, 1.41	0.472			
High school or above	0.63	0.43, 0.92	<b>0.019</b>	0.56	0.21, 1.53	0.13
Body mass index	1.00	0.69, 1.46	0.988			
Hypertension	2.42	1.56, 3.73	< <b>0.001</b>	1.37	0.43, 4.41	0.4
Diabetes	2.94	1.67, 5.16	<b>0.001</b>	2.89	0.81, 10.3	0.069
Smoker	1.50	0.95, 2.38	0.080			
Serum B12	1.00	1.00, 1.00	0.347			
Serum folate	1.02	1.00, 1.04	<b>0.037</b>	1.00	0.96, 1.04	0.7
Serum calcium	1.10	0.61, 1.99	0.730			
Serum phosphorus	1.55	1.05, 2.28	<b>0.028</b>	1.73	0.53, 5.59	0.2
Uric acid	1.11	0.98, 1.25	0.099			
Total cholesterol	0.99	0.99, 1.00	<b>0.049</b>	1.00	0.98, 1.02	0.8
HDL-C	1.00	0.99, 1.01	0.956			
Hemoglobin	0.76	0.64, 0.91	<b>0.006</b>	0.89	0.55, 1.43	0.4
Serum 25(OH)D	1.01	1.00, 1.01	<b>0.018</b>	1.00	0.98, 1.02	0.8
Urine creatinine	1.00	1.0, 1.00	0.736			



Characteristic	Univariate regression			Multivariate regression		
	OR <sup>1</sup>	95% CI <sup>1</sup>	p-value	OR <sup>1</sup>	95% CI <sup>1</sup>	p-value
BUN	1.06	1.04, 1.08	<0.001	0.98	0.92, 1.05	0.3
Serum creatinine	2.24	0.94, 5.33	0.065			
CAD	3.15	1.67, 5.92	0.002	1.79	0.41, 7.87	0.2
Folic acid intake	1.00	1.00, 1.00	0.602			
Vitamin B12 intake	0.99	0.94, 1.05	0.790			
eGFR	0.98	0.97, 0.99	<0.001	1.00	0.96, 1.05	0.9
High MMA	2.04	1.37, 3.06	0.002	1.27	0.44, 3.69	0.4

<sup>1</sup>OR = Odds Ratio, CI = Confidence Interval