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Conference Abstract

YI 2.3 Methylglyoxal, 3-Deoxyglucosone, and Glyoxal – Precursors of Advanced Glycation Endproducts – are not Independently Associated with Indices of Carotid Stiffness: The Maastricht Study

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ABSTRACT

Background: Arterial stiffness is a strong predictor of cardiovascular diseases and all-cause mortality [1]. Increased fasting plasma concentrations of highly reactive dicarbonyl compounds – methylglyoxal (MGO), 3-deoxyglucosone (3-DG), and/or glyoxal (GO) – may cause arterial stiffening via for mation of advanced glycation endproducts, triggering maladaptive responses in vascular tissue, e.g. elastin degradation and collagen cross-linking [2]. We assessed the cross-sectional associations between MGO, 3-DG, and GO concentrations with local carotid stiffness measures (distensibility coefficient (cDC), radius-wall thickness ratio (cRWT), pulse wave velocity (cPWV), and Young's elastic modulus (cE) using standardized main variables.

Methods: Fasting dicarbonyl concentrations were determined by ultra-performance liquid chromatography tandem mass spectrometry in EDTA plasma collected from 2275 participants (age: 60 ± 8 years, mean ± SD; 49% women, 605 with type 2 diabetes mellitus) of the Maastricht Study [3], an observational, population-based cohort study. Cross-sectional associations were assessed using multivariable linear regression analysis adjusting for age, sex, mean arterial pressure (MAP), heart rate, lifestyle factors, and medication. Since arterial stiffness measures are intrinsically pressure dependent, we additionally assessed the associations with pressure-corrected counterparts [4], instead of statistically correcting for MAP.

Results: Fasting dicarbonyl concentrations were associated with arterial stiffening (smaller cDC; larger cPWV and cE) in most crude models, but not in adjusted models (Table). cRWT was associated with 3-DG, but only in the crude model. The use of pressure-corrected metrics did not materially change the final models.

Conclusion: Fasting plasma concentrations of either MGO, 3-DG, or GO are not independently associated with carotid stiffness in this cross-sectional analysis.

Table | Associations between fasting plasma dicarbonyls and carotid stiffness measures

Model		cDC β (95% CI)	cRWT β (95% CI)	cPWV β (95% CI)	cE β (95% CI)
MGO	**0**	**–0.104(–0.145;–0.063)**	**0.011(–0.030;0.052)**	**0.103(0.062;0.144)**	**0.099(0.059;0.140)**
	1	–0.032(–0.070;0.005)	0.010(–0.032;0.052)	0.032(–0.006;0.071)	0.033(–0.007;0.072)
	2	0.005(–0.029;0.039)	0.000(–0.042;0.042)	–0.004(–0.039;0.030)	–0.006(–0.042;0.030)
	3	0.003(–0.031;0.037)	0.000(–0. 043; 0.042)	–0.003(–0.038;0.032)	–0.005(–0.040;0.031)
3-DG	0	**–0.164(–0.205;–0.123)**	**0.067(0.026;0.108)**	**0.149(0.108;0.190)**	**0.171(0.131;0.212)**
	1	**–0.102(–0.154;–0.051)**	0.024(–0. 033; 0.082)	**0.075(0.023;0.127)**	**0.093(0.039;0.147)**
	2	–0.037(–0.084;0.009)	0.009(–0.049;0.066)	0.012(–0.036;0.060)	0.027(–0.023;0.076)
	3	–0.018(–0.065;0.029)	–0. 004(–0.062; 0.054)	–0.007(–0.056;0.041)	0.004(–0.045;0.054)
GO	0	**–0.054(–0.095;–0.013)**	–0.032(–0.074;0.009)	**0.054(0.012;0.095)**	0.038(–0.003;0.079)
	1	–0.015(–0.051;0.022)	–0.014(–0.055; 0.026)	0.015(–0.022;0.052)	0.008(–0.030;0.046)
	2	0.002(–0.031;0.035)	–0.015(–0.056;0.025)	–0.002(–0.035;0.032)	–0.008(–0. 042;0. 027)
	3	–0.009(–0.042;0.024)	–0.013(–0.053; 0.028)	0.011(–0.022;0.045)	0.005(–0.030;0.040)

Model 0: crude associations. Model 1: model 0 + age, sex, and glucose metabolism status. Model 2: model 1 + mean arterial pressure and mean heart rate, and anti-hypertensive drugs. Model 3: model 2 + body mass index, smoking status, physical activity, use of lipid-modifying drugs, fasting triglycerides and total-to-high-density lipoprotein cholesterol levels, alcohol use, history of cardiovascular disease, kidney function, and Dutch healthy diet score. MGO, methylglyoxal; 3DG, 3-deoxyglucosone; GO, glyoxal; cDC, carotid distensibility coefficient; cRWT, carotid radius-wall thickness ratio; cPWV, carotid pulse wave velocity; cE, carotid Young's elastic modulus. Significant associations ($p < 0.05$) printed in bold.

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REFERENCES

[1] Sutton-Tyrrell K, Najjar SS, Boudreau RM, Venkitachalam L, Kupelian V, Simonsick EM, et al. Elevated aortic pulse wave velocity, a marker of arterial stiffness, predicts cardiovascular events in well-functioning older adults. Circulation 2005;111:3384–90.
[2] Schalkwijk CG, Stehouwer CDA. Methylglyoxal, a highly reactive dicarbonyl compound, in diabetes, its vascular complications, and other age-related diseases. Physiol Rev 2020;100:407–61.
[3] Schram MT, Sep SJS, van der Kallen CJ, Dagnelie PC, Koster A, Schaper N, et al. The Maastricht study: an extensive phenotyping study on determinants of type 2 diabetes, its complications and its comorbidities. Eur J Epidemiol 2014;29:439–51.
[4] Bos S, Bruno RM, Spronck B, Heusinkveld M, Taddei S, Ghiadoni L, et al. Blood pressure lowering halts carotid artery stiffening in hypertensive patients: the CATOD study. Artery Res 2017;20:71–2.