Supplement

Creating Composite Indices from Continuous Variables to Advance Diabetes-related Research: the Geometric Mean

Contents

Table S1: Potential Composite Indices Constructed from Continuous Variables

Construct	Nature of Components	Examples of Components
Glycemia	Measures of poor glycemic control	HbA1c, fructosamine, fasting glucose, inverse of time-in-target from CGM, inverse of CV from CGM
Renal disease	Measures of renal disease	Albumin to creatinine ratio, cystatin, inverse of eGFR
Cognitive health	Cognitive tests where higher score signifies better function	DSST, MOCA, MMSE
Heart Disease	Biomarkers positively linked to heart disease	LDL, apoprotein B, systolic blood pressure, diastolic blood pressure, inverse of eGFR, troponin, NT-proBNP
Infection	Body's response to infection or inflammation	Heart rate, temperature, white cell count, respiratory rate

Variables that are inversely correlated with the construct can be included by using the calculated reciprocal value of the variable; CGM – continuous glucose monitoring; CV – coefficient of variation; BMI – body mass index

Table S2: Individual Components of Each Composite Index				
Index	N	Component Variable	Mean (SD) of Ln (Component Variable)	Mean (SD) Z-Score
Glycemia	12345	FPG	1.96 (0.25)	0.00 (1.00)
	12345	HbA1c	1.86 (0.15)	0.00 (1.00)
Renal	12187	1/eGFR	-4.31 (0.27)	0.00 (1.00)
	12187	ACR	-0.08 (1.66)	0.00 (1.00)
Cognitive	3676	MMSE	3.30 (0.13)	0.00 (1.00)
	3676	DSST	3.46 (0.57)	0.00 (1.00)

ACR – albumin-to-creatinine ratio; eGFR – estimated glomerular filtration rate; MMSE –Mini Mental State Exam; DSST – Digit Symbol Substitution Test; FPG – Fasting plasma glucose; HbA1c – hemoglobin A1c

Table S3: Summary Statistics for the Composite Z-score and Geometric Mean of Each Index

Index	Components	Composite Z-score[a]		Geometric Mean[b]	
		Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Glycemia	FPG & HbA1c	0.00 (0.86)	-0.07 (-0.61, 0.57)	1.91 (0.17)	1.89 (1.79, 2.02)
Renal	ACR & 1/eGFR	0.00 (0.75)	-0.11 (-0.52, 0.40)	4.18 (0.56)	4.06 (3.77, 4.47)
Cognitive	MMSE & DSST	0.00 (0.82)	0.17 (-0.37, 0.56)	3.37 (0.33)	3.43 (3.22, 3.59)

[a]Arithmetic mean of each person's 2 component Ln-transformed Z-scores; [b]Geometric mean of each person's 2 component Ln-transformed scores; ACR – albumin-to-creatinine ratio; eGFR – estimated glomerular filtration rate; MMSE –Mini Mental State Exam; DSST – Digit Symbol Substitution Test; FPG – Fasting plasma glucose; HbA1c – hemoglobin A1c

Figure S1: Formulae for calculating the arithmetic and geometric mean

$$Geometric\ Mean\ (a,b) \quad = \quad (a*b)^{1/2}$$

$$Geometric\ Mean\ (a,b,c,d) \quad = \quad (a*b*c*d)^{1/4}$$

$$Arithmetic\ Mean\ (a,b) \quad = \quad (a+b)/2$$

$$Arithmetic\ Mean\ (a,b,c,d) \quad = \quad (a+b+c+d)/4$$

Figure S2: Quantile-Quantile (Q-Q) plots of composite indices reflecting cognitive status (Panel A), renal status (Panel B), and glycemia (Panel C). For each panel, the y-axis is the quantile of the arithmetic mean of the 2 component standardized score, and the x-axis is the geometric mean of the 2 components.