Correlation between CGM-Derived Mean Glycemia and Measured Hemoglobin A1c in the Real World

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Background

A published regression equation converts continuous glucose monitoring (CGM)-derived mean glycemia into an estimate of laboratory-measured HbA1c, termed glucose management indicator (GMI)[1]. Whether such GMI formulas differ by CGM device is not known.

Objectives

(1) To determine whether the regression equation to compute the GMI is different for the FreeStyle Libre CGM compared to a published equation, which is based on Dexcom CGM technology. (2) To evaluate differences of the regression equation to compute GMI among different races.

METHODS

Observational study using electronic health record (EHR) data among patients with diabetes and a minimum of 10 days of sensor glucose data collected with FreeStyle Libre CGM (Personal or Pro). For this abstract, we restricted the analysis to patients with measurement of HbA1c within +/-1 day of the CGM download date. We plotted HbA1c and CGM mean glucose and derived a Libre-specific regression equation. We compared the GMI derived from the Libre-specific equation (GMI_L) with the published formula (GMI_P).

Results

Patient characteristics [N=103]

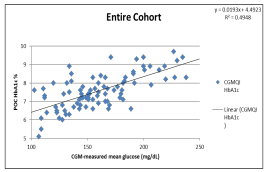
Demographic Characteristics	
Age, years	62
Women, no (%)	35 (34)
Race/Ethnicity, no (%)	
White	52 (50.5)
Black or African-American	20 (19.4)
Asian (Chinese or Vietnamese)	22 (21.4)
Hispanic	7 (6.8)
Other/Unknown	2 (1.9)

Clinical Characteristics	
Body Mass Index, lb/inch²	30.0±6.4
Diabetes type, no (%)	
Type 1	13 (12.6)
Type 2	78 (75.7)
Type 2, insulin	9 (8.7)
Other [1]	3 (2.9)
Years of diagnosis, mean (range)	15 (<1-50)
Hemoglobin A1c, %[2]	7.8±1.4

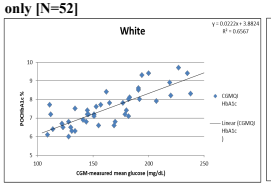
CGM Data	
FreeStyle Libre Pro, no (%)	61 (59.2)
FreeStyle Libre Personal, no (%)	42 (40.8)
Days with CGM data, mean (range)	26 (10-90)
CGM Mean glucose (mg/dL)	174±52
GMI_P (%)[3]	7.5±1.2

Values are means ± SD unless otherwise specified;
[1]Diabetes Type "Other" is reported for pancreatic disease (n=1), pre-diabetes (n=1) and reactive hypoglycemia (n=1)
[2] Hemoglobin A1c measured by DCA Vantage (Siemens, city, STATE)
[3] Published GMI

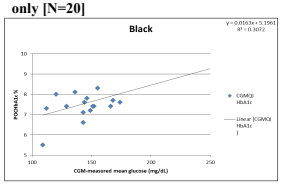
HbA1c vs. Libre CGM-derived mean glucose concentration – entire cohort [N=103]



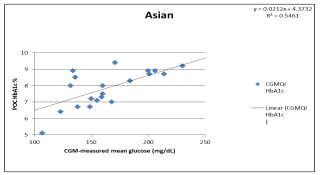
HbA1c vs. Libre CGM-derived mean glucose concentration – white patients only [N=52]



HbA1c vs. Libre CGM-derived mean glucose concentration – black patients only [N=20]



HbA1c vs. Libre CGM-derived mean glucose concentration – Asian patients only [N=22]



GMI_P and GMI_L for typical CGM-derived mean glucose levels

Typical CGM-derived mean glucose (mg/dL)	Entire Cohort		Race specific sub-groups		
	GMI_P	GMI_L	GMI_L White	GMI_L Black	GMI_L Asian
100	5.7	6.4	6.1	6.8	6.5
125	6.3	6.9	6.7	7.2	7.0
150	6.9	7.4	7.2	7.6	7.6
175	7.5	7.9	7.8	8.0	8.1
200	8.1	8.4	8.3	8.5	8.6
225	8.7	8.8	8.9	8.9	9.1
250	9.3	9.3	9.4	9.3	9.7
275	9.9	9.8	10.0	9.7	10.2
300	10.5	10.3	10.5	10.1	10.7

GMI_P (published GMI) = 3.31 + 0.02392 x [mean glucose in mg/dL]
GMI_L (Libre GMI) = 4.4923+0.0193 x [mean glucose in mg/dL]
GMI_L white = 3.8824+0.0222 x [mean glucose in mg/dL]
GMI_L black = 5.1961+0.0163 x [mean glucose in mg/dL]
GMI_L Asian = 4.3732+0.0212 x [mean glucose in mg/dL]

Results (cont.)

Comparison of published GMI vs Libre specific GMI

CGM-derived mean glucose (mg/dL)	GMI_P	GMI_L	P value
Entire Cohort (n=103)	7.5	7.9	0.01
White patients (n=52)	7.6	7.9	0.27
Black-African American (n=20)	7.4	8.0	0.14
Asian (n=22)	7.2	7.9	0.03

P value for the difference in means between GMI-P and GMI-L

Limitations

Our population [mainly type 2 diabetes, mean number of days with CGM prior to HbA1c 26 (range 10-90)] differs from the one used to compute the published GMI equation [mainly type 1 diabetes, mean number of days with CGM prior to HbA1c 48 (range 13-89)].

Conclusion

The GMI derived from a Libre-specific regression equation differs from the published GMI based on data collected with different devices. GMI_L also appears to vary by race. Development of a device-specific and race-specific GMI may be warranted.

References

[1]Bergenstal RM, et al. Glucose Management Indicator (GMI): A New Term for Estimating A1C From Continuous Glucose Monitoring. Diabetes Care. 2018;41(11):2275-80.